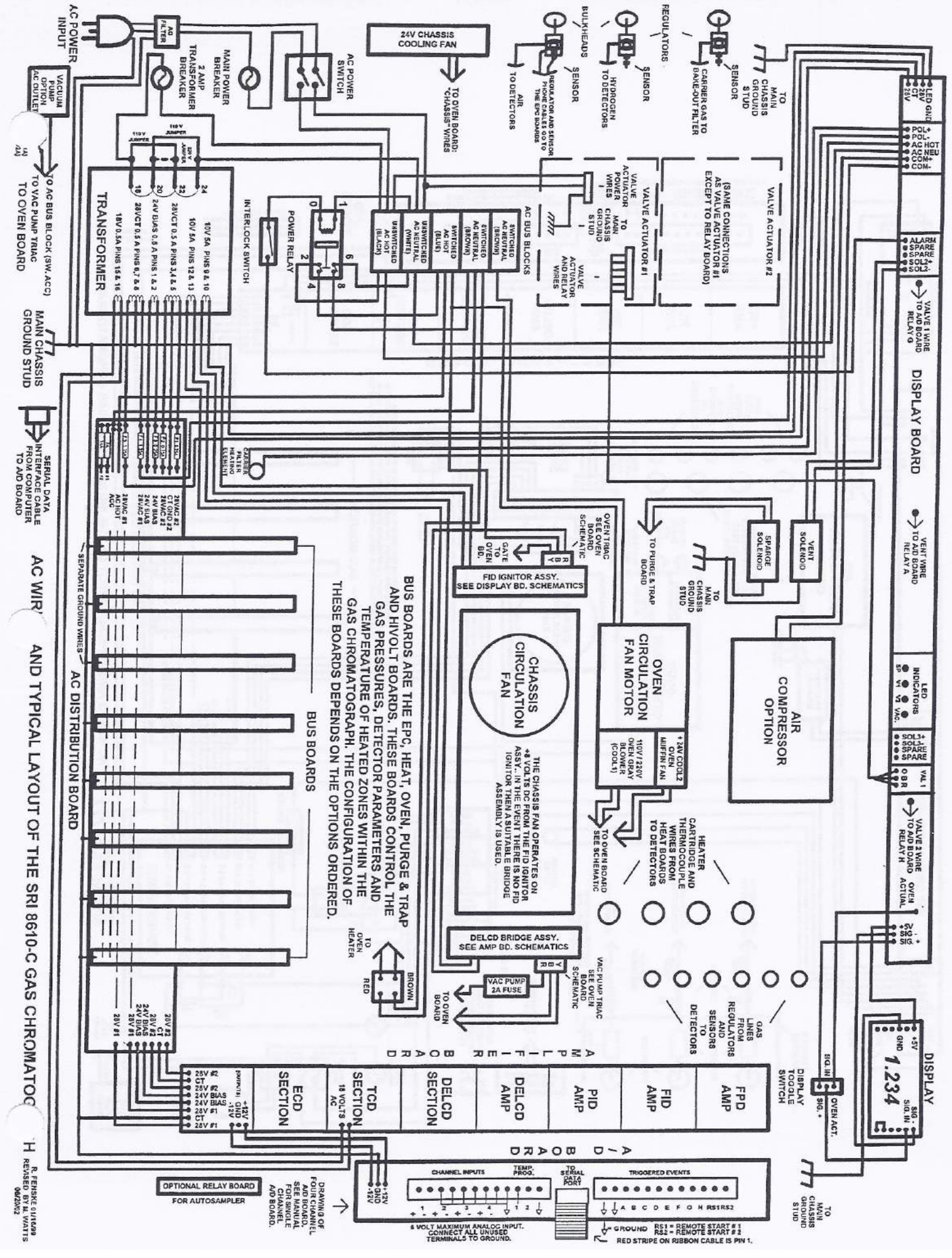


SCHEMATIC INDEX (page 1)

CIRCUIT BOARD SCHEMATIC	R E V	CIRCUIT DESCRIPTION	USED IN MODELS:			
			8610	310	110	202/203
MODEL 8610-C LAYOUT	C	AC WIRING AND TYPICAL LAYOUT OF 8610-C GAS CHROMATOGRAPH	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MODEL 310 LAYOUT	B	AC WIRING AND TYPICAL LAYOUT OF 310 GAS CHROMATOGRAPH	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
AC DISTRIBUTION BD. 8610/310	C/A	DISTRIBUTES 110/220 AC VOLTAGE AND 28 VAC THROUGHOUT THE G.C.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8610 DISPLAY BD. (page 1)	G	EPC, TEMPERATURE & DETECTOR PARAMETER SETPOINT CIRCUITS	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8610 DISPLAY BD. (page 2)	G	ALARM, CARRIER FILTER, AIR COMP., DISPLAY DRIVER	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8610 DISPLAY BD. (page 3)	G	FID IGNITOR, VALVE ACTUATOR RELAYS, SPLIT VENT SOLENOID	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
310 DISPLAY BD. (page 1)	C	EPC, TEMPERATURE & DETECTOR PARAMETER SETPOINT CIRCUITS	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
310 DISPLAY BD. (page 2)	C	ALARM, CARRIER FILTER, AIR COMP., DISPLAY DRIVER	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
310 DISPLAY BD. (page 3)	C	FID IGNITOR, VALVE ACTUATOR RELAYS, SPLIT VENT SOLENOID	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
110 DISPLAY BD. (page 1)	B	EPC, TEMPERATURE & DETECTOR PARAMETER SETPOINT CIRCUITS	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
110 DISPLAY BD. (page 2)	B	FID IGNITOR, AIR COMP., DISPLAY DRIVER	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
EPC BOARD	D	ELECTRONIC GAS PRESSURE CONTROL	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
OVEN BOARD (page 1)	E	POWER SUPPLY, JITTER CIRCUIT, CHASSIS COOLING FAN CIRCUIT	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
OVEN BOARD (page 2)	E	COLUMN OVEN HEATING AND COOLING CIRCUITS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
HEAT BOARD (page 1)	E	TEMPERATURE CONTROL OF HEATED ZONES. CIRCUIT 1.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
HEAT BOARD (page 2)	E	TEMPERATURE CONTROL OF HEATED ZONES. CIRCUITS 2 & 3.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
PURGE & TRAP BD. (page 1)	C	TRAP 1 HEATING CIRCUIT, TRAP COOLING	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PURGE & TRAP BD. (page 2)	C	TRAP 2 HEATING CIRCUIT, SPARGE GAS SOLENOID	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
HIVOLT BOARD	B	HIGH VOLTAGE POWER SUPPLY FOR FPD AND PID DETECTORS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
AMP BOARD (page 1)	D	AMPLIFIER BOARD POWER SUPPLIES	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
AMP BOARD (page 2)	D	TCD PROTECT CIRCUIT, POWER SUPPLY & AMPLIFIER	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
AMP BOARD (page 3)	D	ECD CIRCUITRY & AMPLIFIER	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
AMP BOARD (page 4)	D	DELCD POWER SUPPLY	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
AMP BOARD (page 5)	D	FID & DELCD AMPLIFIERS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
AMP BOARD (page 6)	D	PID & FPD AMPLIFIERS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
AMP BOARD (page 7)	D	OPTIONAL ZERO POTS AND ATTENUATORS FOR DETECTOR AMPLIFIERS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
ACCESSORY RELAY BD.	A	A/D INTERFACE BOARD FOR AUTO-SAMPLERS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SPME BOARD (page 1)	A	SINGLE PHASE MICRO-EXTRACTION CONTROL CIRCUIT	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SPME BOARD (page 2)	A	TEMPERATURE CONTROL OF HEATED ZONES. CIRCUITS 2 & 3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



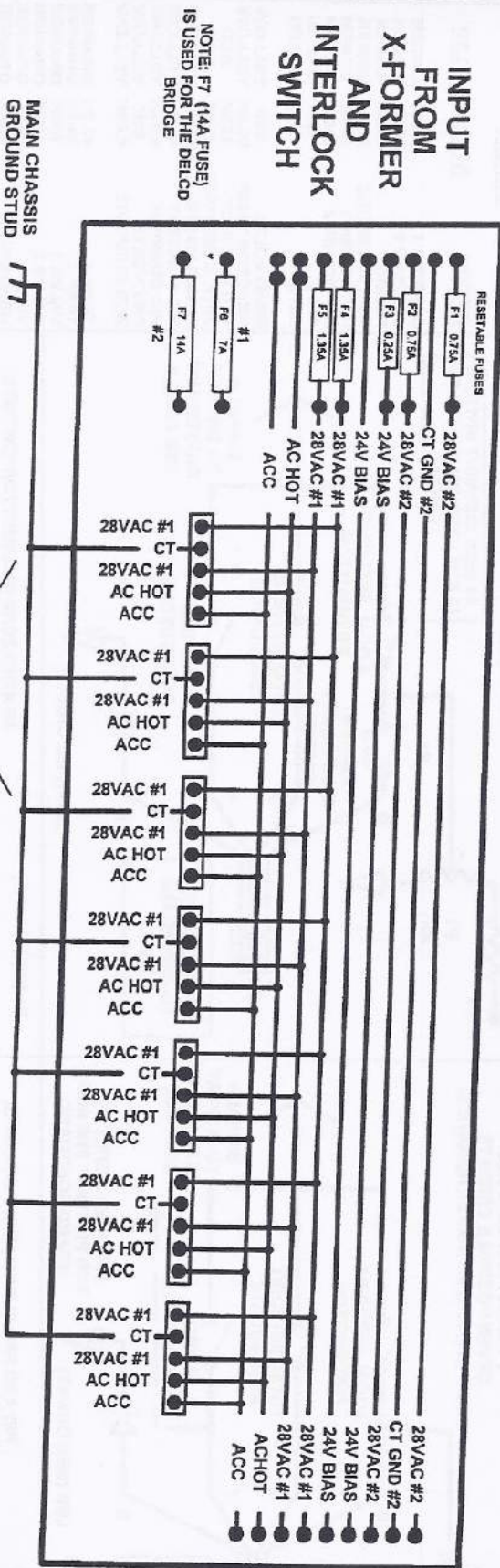
BUS BOARDS ARE THE EPC, HEAT, OVEN, PURGE & TRAP AND H/VOLT BOARDS. THESE BOARDS CONTROL THE GAS PRESSURES, DETECTOR PARAMETERS AND TEMPERATURE OF HEATED ZONES WITHIN THE GAS CHROMATOGRAPH. THE CONFIGURATION OF THESE BOARDS DEPENDS ON THE OPTIONS ORDERED.

THE CHASSIS FAN OPERATES ON +8 VOLTS DC FROM THE FID IGNITOR ASSEMBLY. IN THE EVENT THERE IS NO FID IGNITOR THEN A SUITABLE BRIDGE ASSEMBLY IS USED.

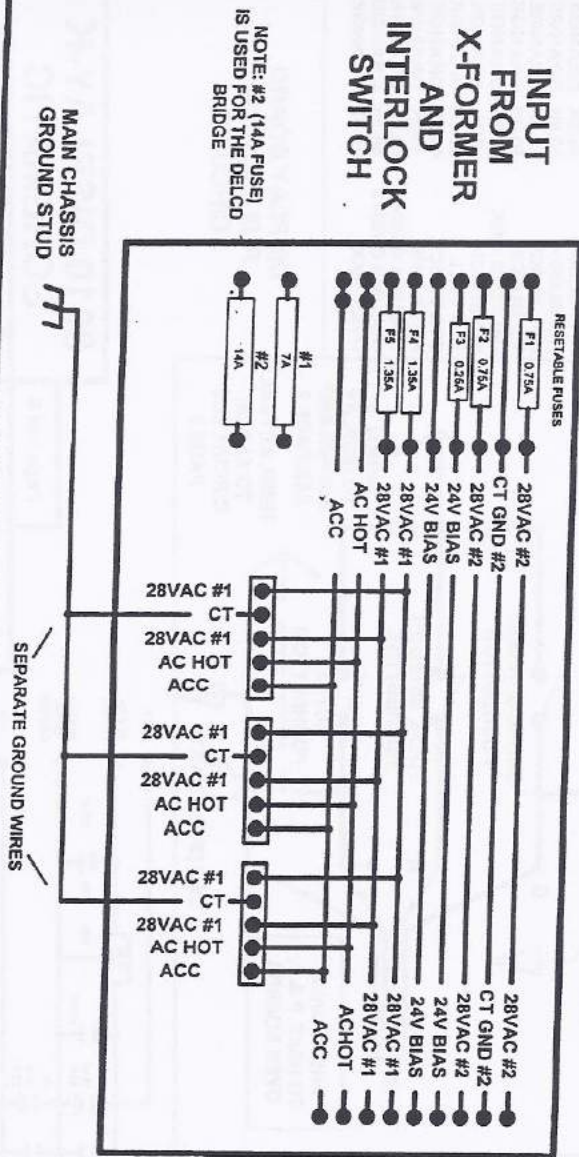
6 VOLT MAXIMUM ANALOG INPUT. CONNECT ALL UNUSED TERMINALS TO GROUND.

RED STRIPE ON RIBBON CABLE IS PIN 1.

8610 AC DISTRIBUTION BOARD



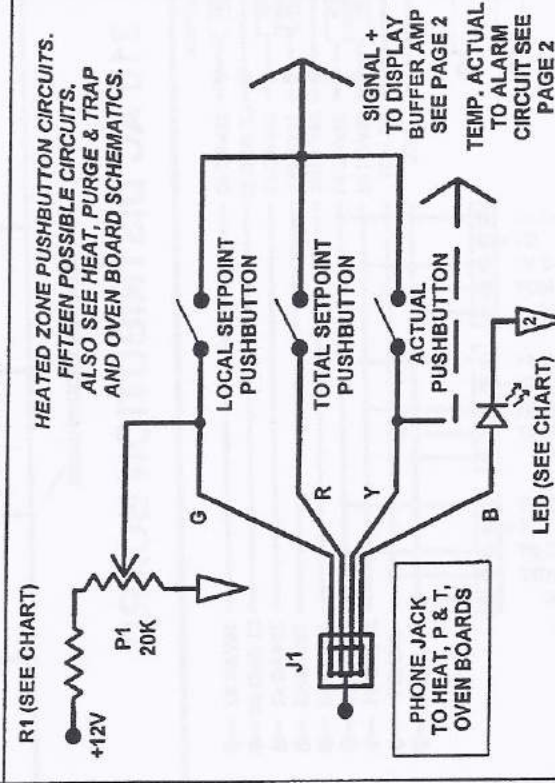
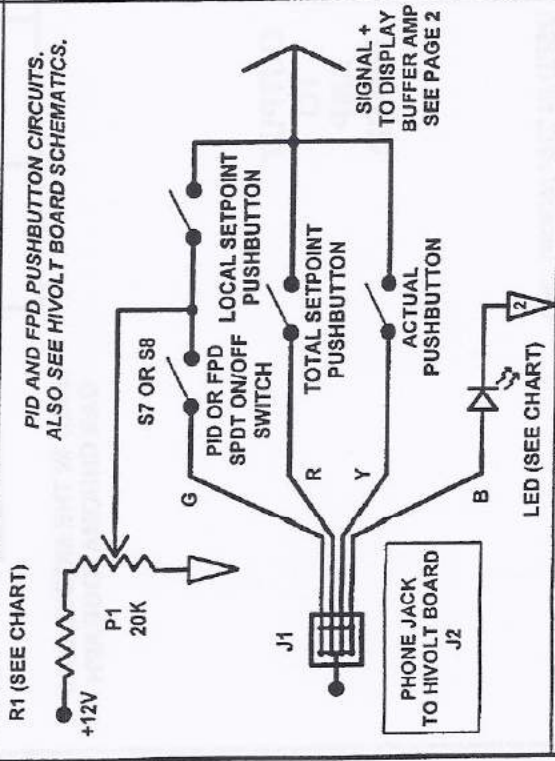
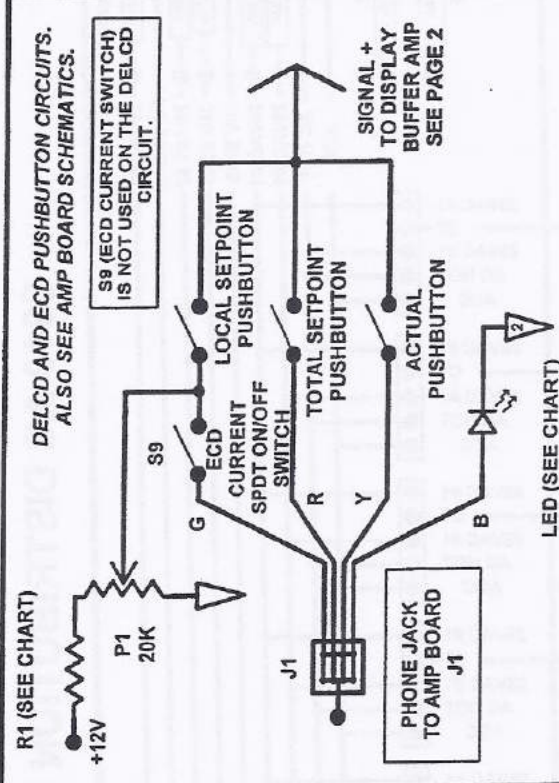
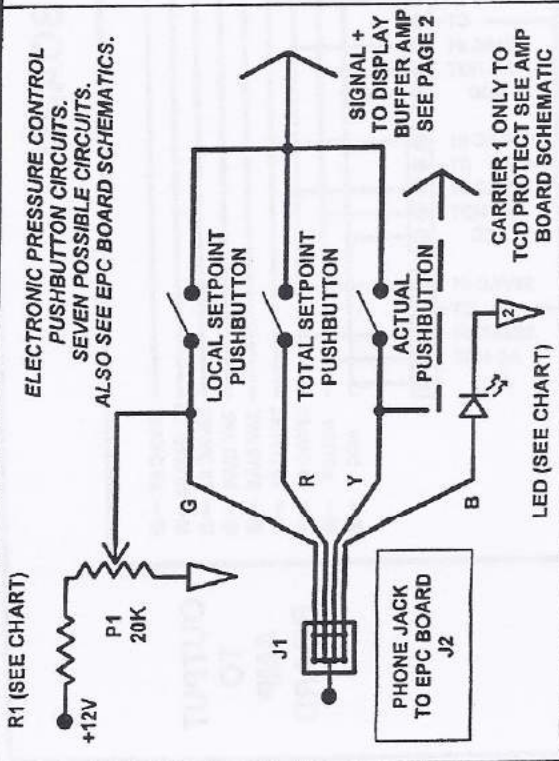
310 AC DISTRIBUTION BOARD



USED IN THE MODEL 310 GAS CHROMATOGRAPH

USED IN THE MODEL 8610 GAS CHROMATOGRAPH

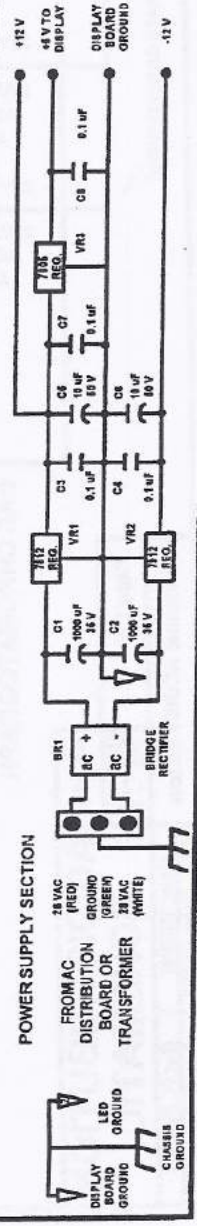
Bd. REV.	8610 - D	AC DISTRIBUTION SCHEMATIC
	310 - B	
Page 1 of 1	Date: 12/20/97	By: R. Fenske
Filename: ACDIST-ca.tcw	REV. Date: 5/13/02	By: M. Watts



CHART

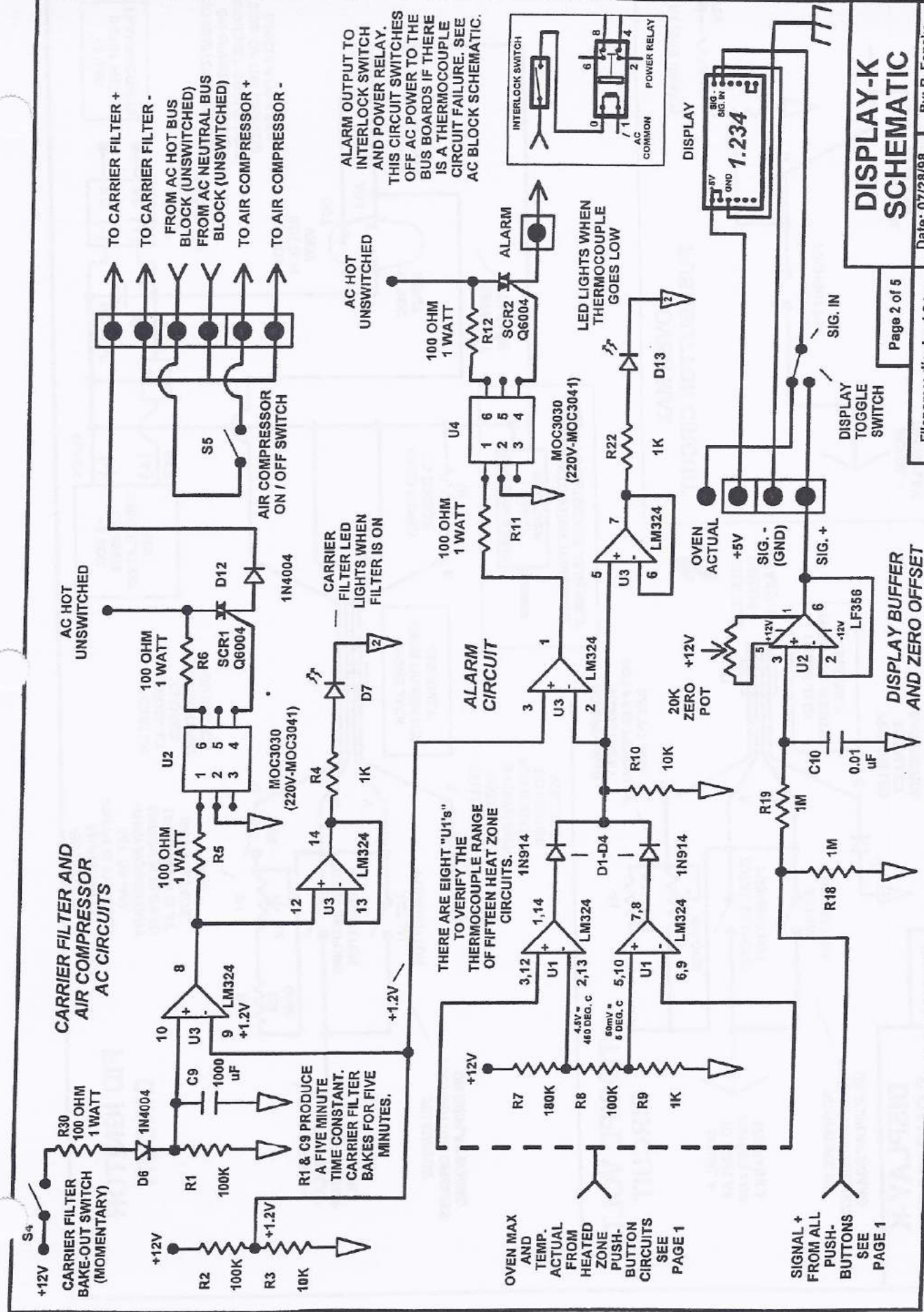
CIRCUIT	R1 VALUE	LED
CARRIER 1	220K	GREEN
CARRIER 2	220K	GREEN
PURGE	2.2M	GREEN
VIAL PRESSURE	220K	GREEN
HYDROGEN 1	220K	GREEN
HYDROGEN 2	220K	GREEN
AIR 1	1M	GREEN
AIR 2	1M	GREEN
BEAD VOLTS	620	YELLOW
REACTOR TEMP	60.4K	YELLOW
TCD PROTECT	483K	RED
VIRT. OVEN PROT.	390K	RED
FLAME IGNITE	100 ohm	YELLOW
PID CURRENT	40.2K	YELLOW
HID CURRENT	4.02K	YELLOW
PMT VOLTS	20K	YELLOW
ECD CURRENT	4.02K	YELLOW
TRAP 1	47.7K	ORANGE
TRAP 2	48.7K	ORANGE
VALVE 1	100K	ORANGE
VALVE 2	100K	ORANGE
VIAL	483K	ORANGE
HEADSPACE	220K	ORANGE
FID w/ METH.	38.3K	ORANGE
DESORBER	60.4K	ORANGE
INJECTOR 1	48.7K	ORANGE
INJECTOR 2	48.7K	ORANGE
FID BLOCK	40.2K	ORANGE
NPD BLOCK	40.2K	ORANGE
HID BLOCK	40.2K	ORANGE
FPD BLOCK	40.2K	ORANGE
TID BLOCK	40.2K	ORANGE
DELCD BLOCK	40.2K	ORANGE
PID BLOCK	40.2K	ORANGE
TCD CELL	76K	ORANGE
ECD BLOCK	60.4K	ORANGE
X-FER LINE	44.2K	ORANGE
100K	100K	ORANGE
COLUMN OVEN 1	40.2K	ORANGE
COLUMN OVEN 2	40.2K	ORANGE
OVEN MAX	40.2K	ORANGE
38.3K	38.3K	ORANGE

DISPLAY BOARD PUSHBUTTON CIRCUITS

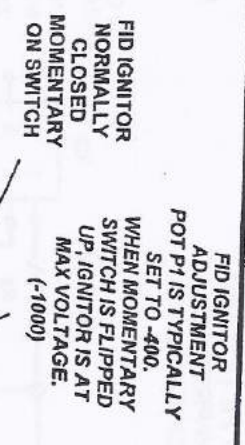
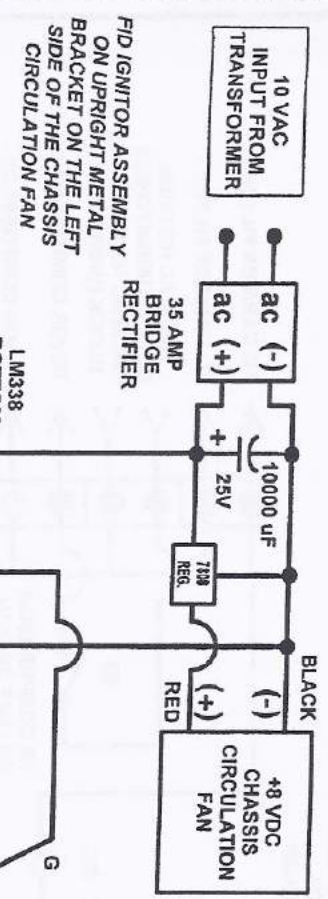


8610 DISPLAY-K SCHEMATIC

Date: 12/20/97 By: R. Fenske
Rev. Date: 10/18/02 By: M. Watts

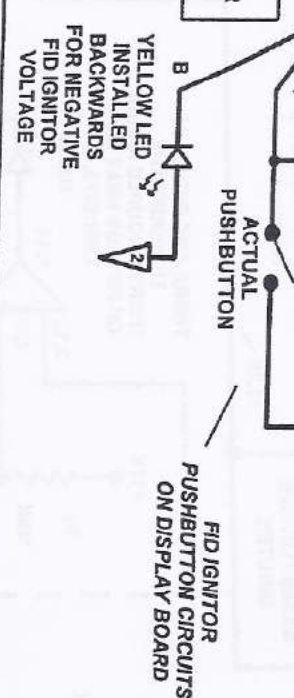


DISPLAY-K-K SCHEMATIC



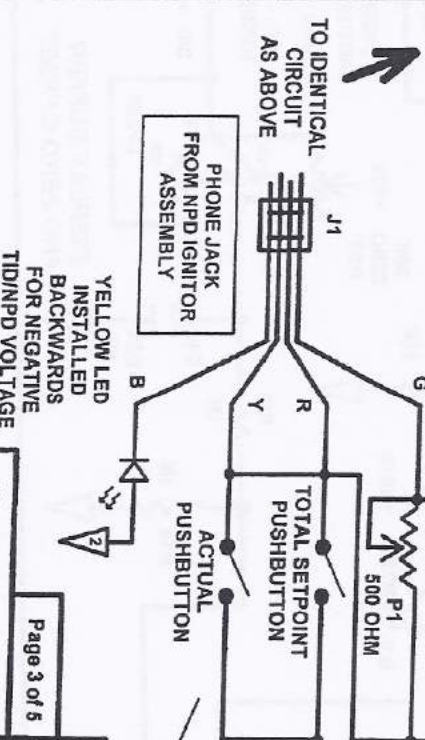
FID IGNITOR CIRCUIT

SIGNAL + TO DISPLAY BUFFER AMP SEE PAGE 2



TID/NPD VOLTS CIRCUIT

SIGNAL + TO DISPLAY BUFFER AMP SEE PAGE 2



DISPLAY-K SCHEMATIC

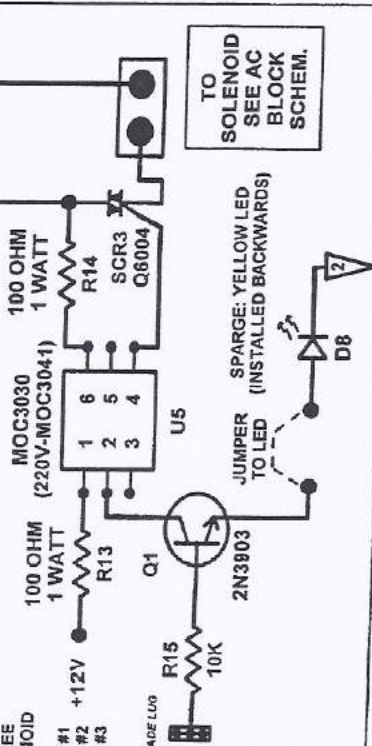
SOLENOID CIRCUIT FOR ACTIVATION OF 'SPARGE', 'SPLIT VENT', 'CRYO TRAP'

SOLENOID CKT. #1

THERE ARE THREE IDENTICAL SOLENOID CIRCUITS.

SOLENOID CKT. #1
SOLENOID CKT. #2
SOLENOID CKT. #3

SOLENOID INPUT FROM A/D BOARD



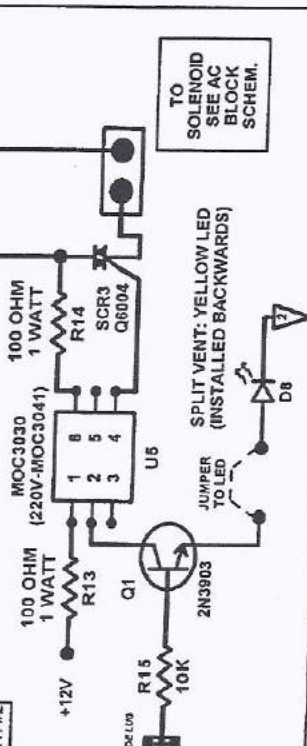
SOLENOID CIRCUIT FOR ACTIVATION OF 'SPARGE', 'SPLIT VENT', 'CRYO TRAP'

SOLENOID CKT. #2

THERE ARE THREE IDENTICAL SOLENOID CIRCUITS.

SOLENOID CKT. #1
SOLENOID CKT. #2
SOLENOID CKT. #3

SOLENOID INPUT FROM A/D BOARD



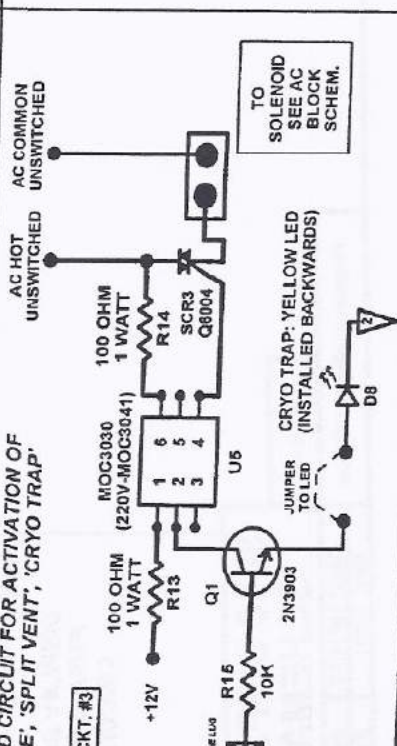
SOLENOID CIRCUIT FOR ACTIVATION OF 'SPARGE', 'SPLIT VENT', 'CRYO TRAP'

SOLENOID CKT. #3

THERE ARE THREE IDENTICAL SOLENOID CIRCUITS.

SOLENOID CKT. #1
SOLENOID CKT. #2
SOLENOID CKT. #3

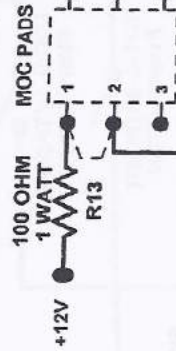
SOLENOID INPUT FROM A/D BOARD



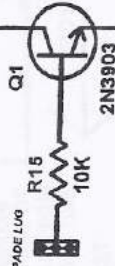
TO LIGHT THE VALVE OR VACUUM PUMP LED(S) ONLY, THIS SECTION OF ANY OF THE THREE SOLENOID CIRCUITS IS USED.

THERE ARE THREE IDENTICAL SOLENOID CIRCUITS TO SELECT FROM. SOLENOID CKT. #1 SOLENOID CKT. #2 SOLENOID CKT. #3

JUMPER PINS 1 & 2 OF THE MOC. DO NOT INSTALL THE CHIP OR THE SOCKET.



VIOLET OR GRAY FROM A/D BOARD

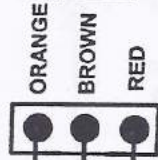


VALVE 2, VACUUM PUMP: YELLOW LED (INSTALLED BACKWARDS)

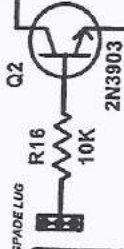


RELAY CIRCUIT FOR ACTIVATION OF 'VALVE 1'

RLY1



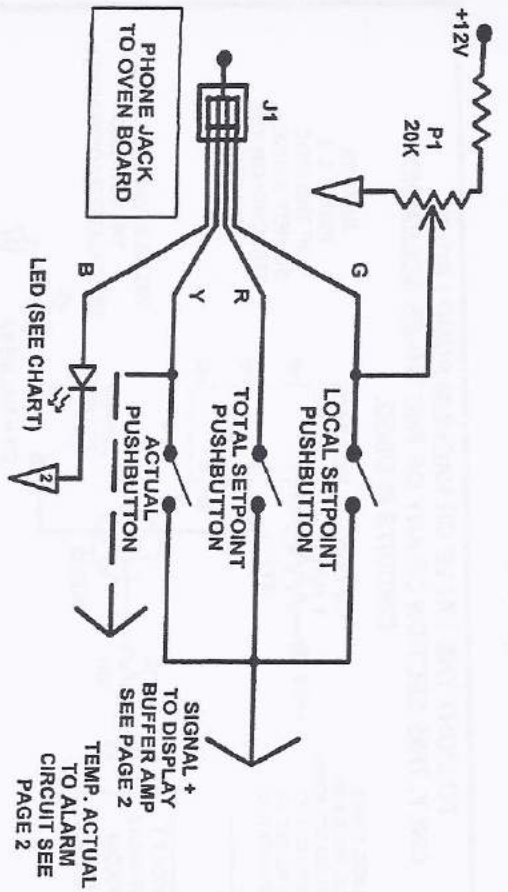
VALVE 1 RELAY 'G' INPUT FROM A/D BOARD



DISPLAY-K SCHEMATIC

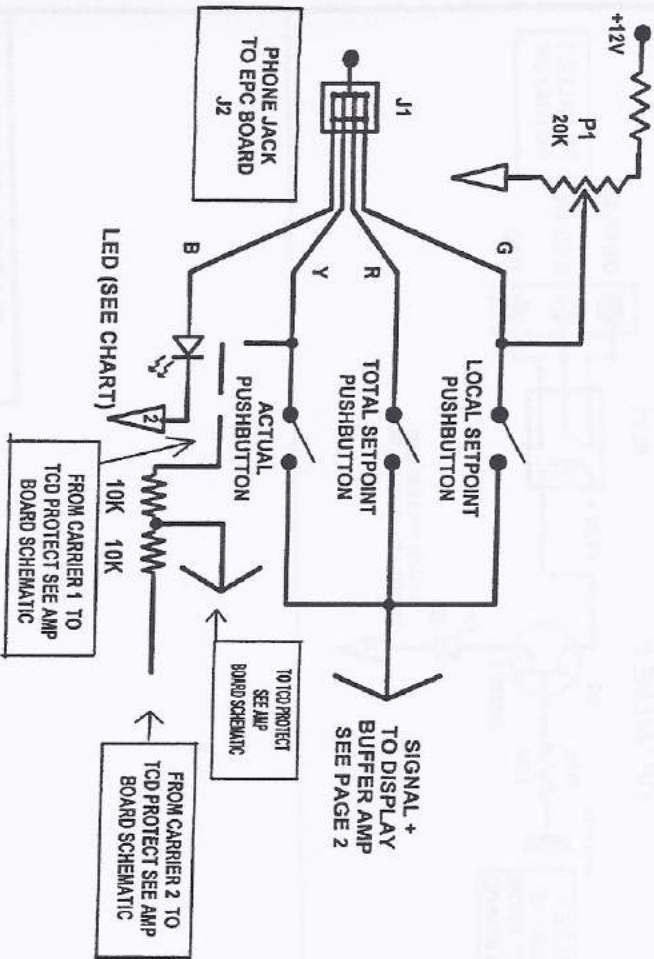
R1 (SEE CHART)

VIRTUAL OVEN PROTECT



R1 (SEE CHART)

MULTIGAS 2 TCD PROTECT



DISPLAY BOARD
PUSHBUTTON
CIRCUITS

8610 DISPLAY-K SCHEMATIC

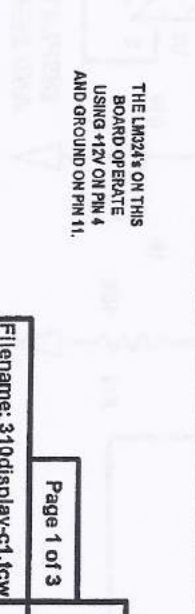
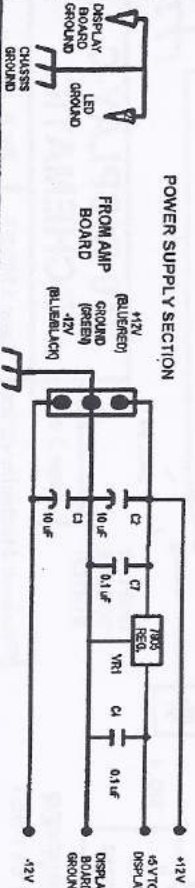
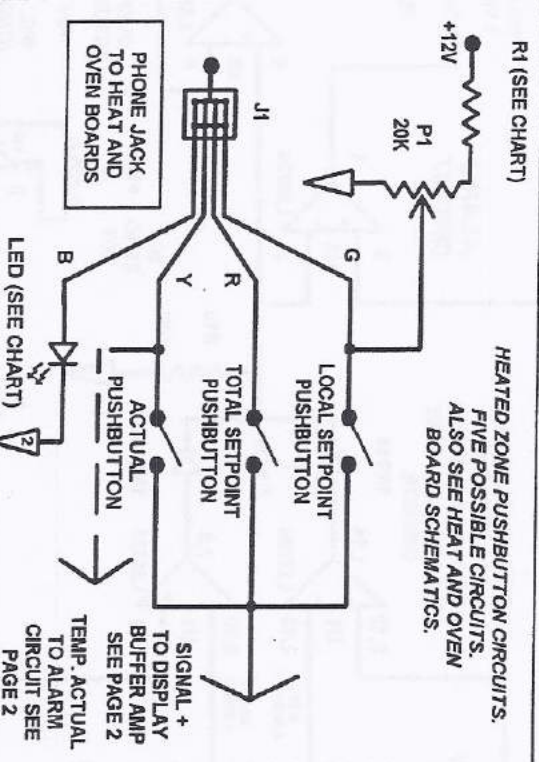
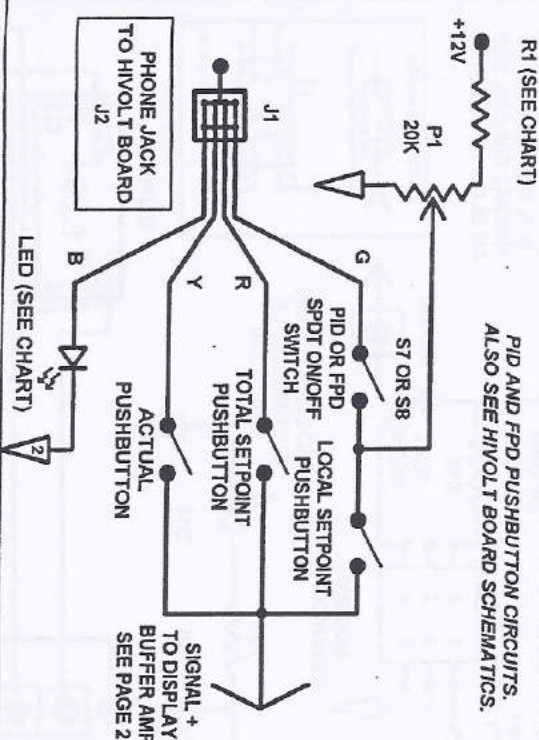
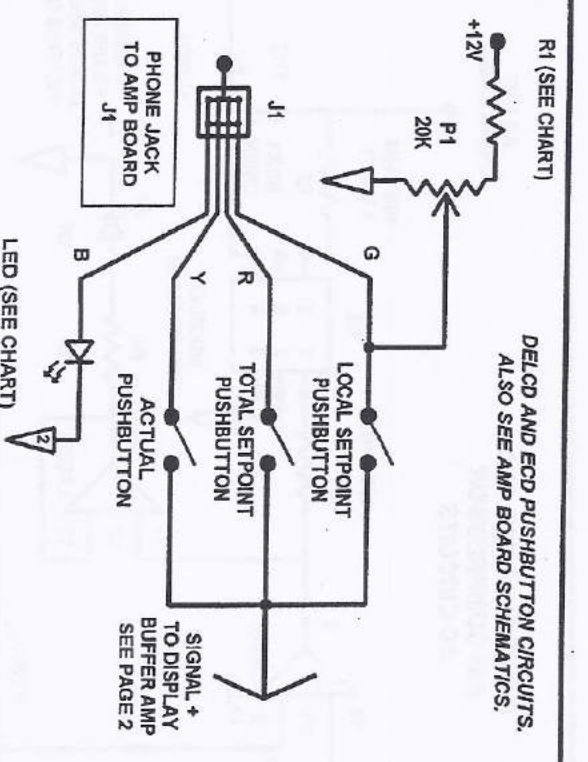
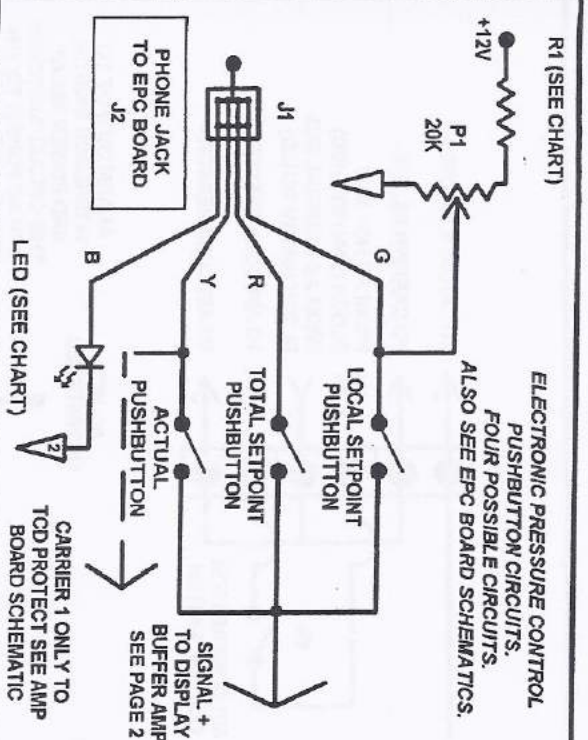
Page 5 of 5

Filenam: display-k5.tcw

Date: 10/18/02

By: M. Watts

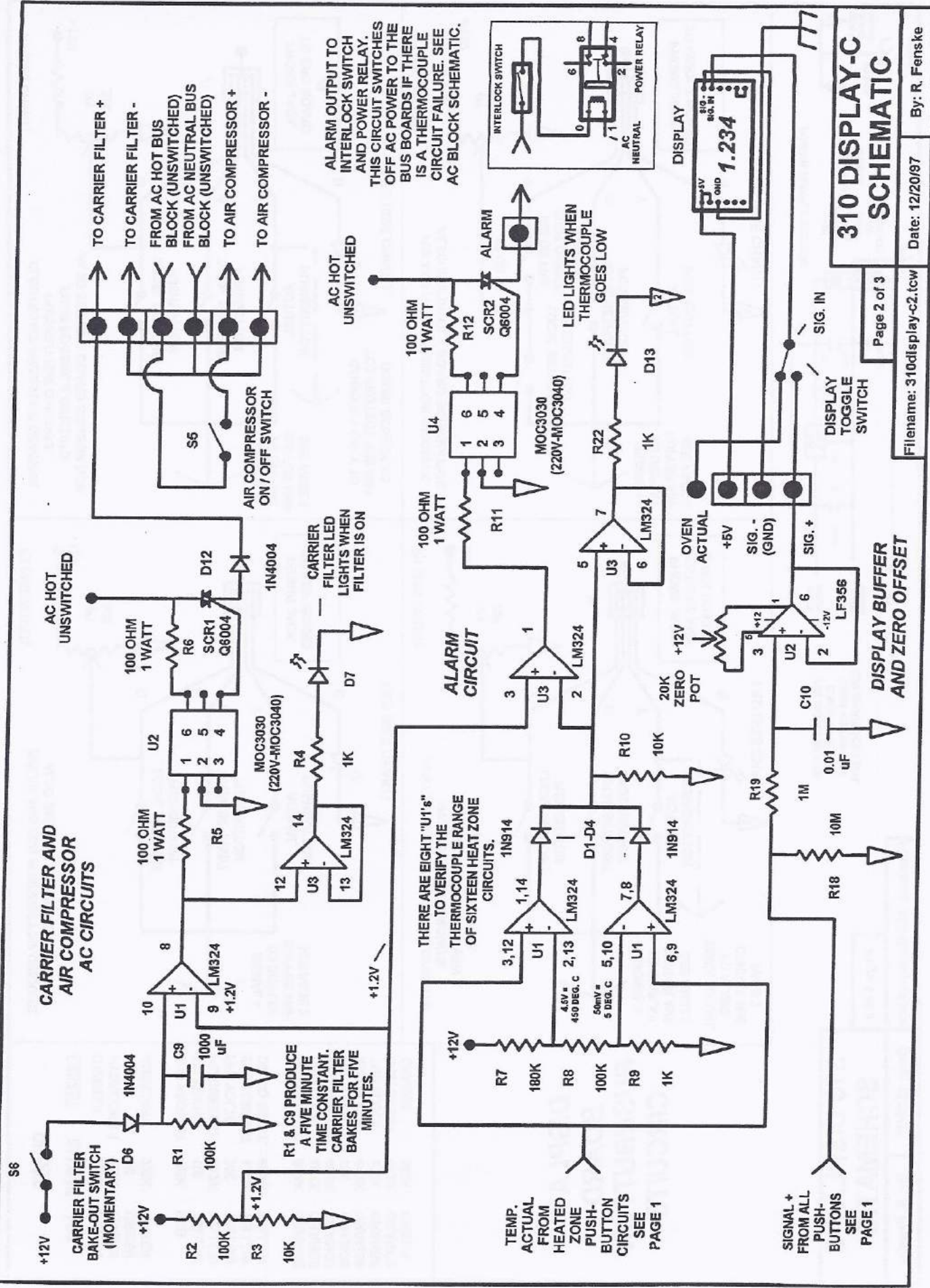
Rev. Date:



CIRCUIT	R1 VALUE	LED
CARRIER 1	220K	GREEN
HYDROGEN 1	220K	GREEN
AIR 1	1M	GREEN
AUXILIARY	220K	GREEN
TCD PROTECT	453K	RED
FID GINTOR	100	YELLOW
PID CURRENT	40.2K	YELLOW
FPD VOLTS	20K	YELLOW
ECD CURRENT	4.02K	YELLOW
DELCD REACT.	60.4K	YELLOW
HEATED INL. 1	60.4K	ORANGE
FID BLOCK	40.2K	ORANGE
DELCD BLOCK	40.2K	ORANGE
PID BLOCK	75K	ORANGE
ECD BLOCK	44.2K	ORANGE
TGD BLOCK	120K	ORANGE
COL. OVEN 1	40.2K	ORANGE
CHASSIS	383K	GREEN

DISPLAY BOARD PUSHBUTTON CIRCUITS

310 DISPLAY-C SCHEMATIC



CARRIER FILTER AND AIR COMPRESSOR AC CIRCUITS

TO CARRIER FILTER +
 TO CARRIER FILTER -
 FROM AC HOT BUS BLOCK (UNSWITCHED)
 FROM AC NEUTRAL BUS BLOCK (UNSWITCHED)
 TO AIR COMPRESSOR +
 TO AIR COMPRESSOR -

ALARM OUTPUT TO INTERLOCK SWITCH AND POWER RELAY. THIS CIRCUIT SWITCHES OFF AC POWER TO THE BUS BOARDS IF THERE IS A THERMOCOUPLE CIRCUIT FAILURE. SEE AC BLOCK SCHEMATIC.

THERE ARE EIGHT "U1's" TO VERIFY THE THERMOCOUPLE RANGE OF SIXTEEN HEAT ZONE CIRCUITS.

TEMP. ACTUAL FROM HEATED ZONE PUSH-BUTTON CIRCUITS SEE PAGE 1

SIGNAL + FROM ALL PUSH-BUTTONS SEE PAGE 1

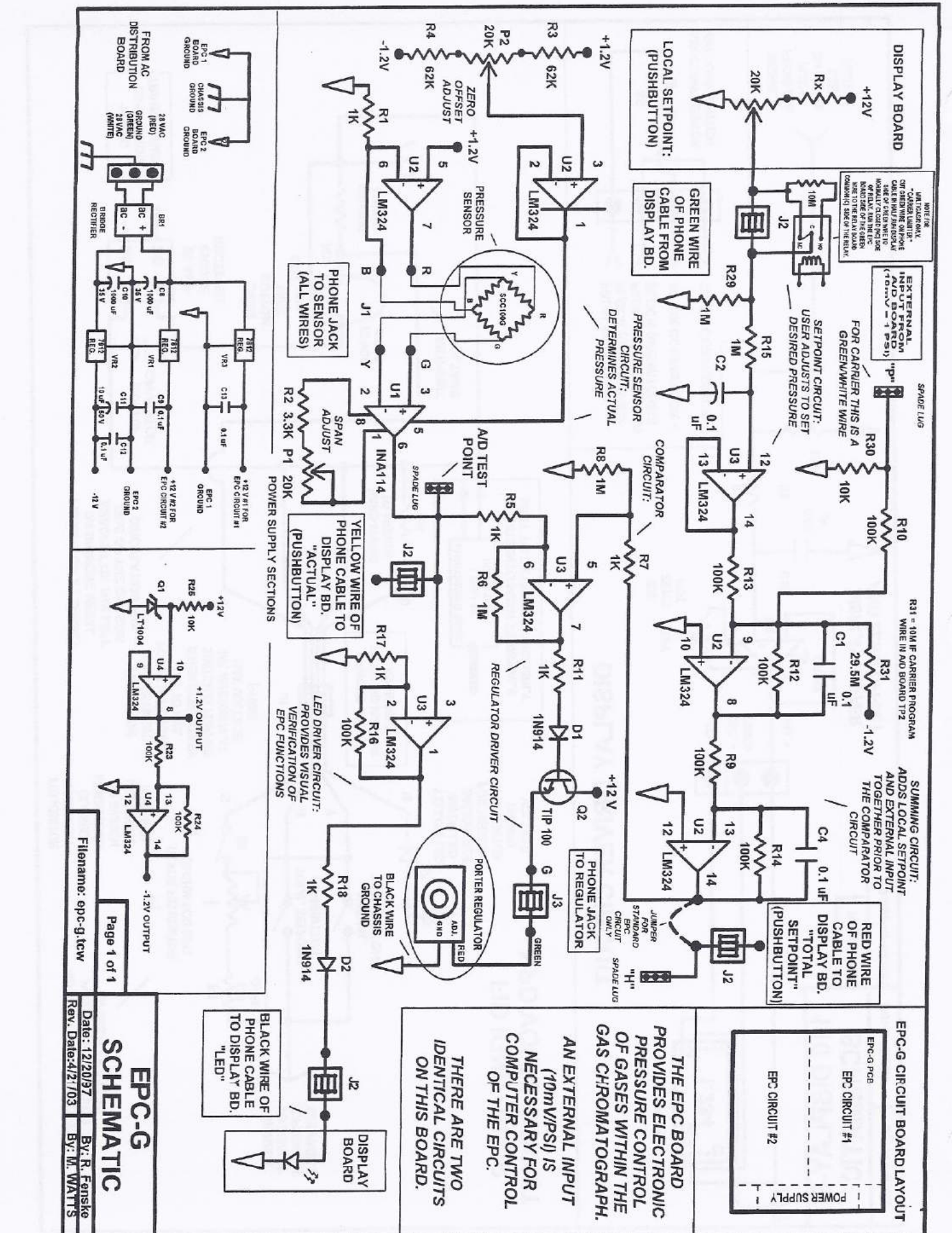
310 DISPLAY-C SCHEMATIC

Page 2 of 3

Filename: 310display-c2.tcw

Date: 12/20/97

By: R. Fanske



THE EPC BOARD PROVIDES ELECTRONIC PRESSURE CONTROL OF GASES WITHIN THE GAS CHROMATOGRAPH. AN EXTERNAL INPUT (10mV/PSI) IS NECESSARY FOR COMPUTER CONTROL OF THE EPC.

THERE ARE TWO IDENTICAL CIRCUITS ON THIS BOARD.

BLACK WIRE OF PHONE CABLE TO DISPLAY BD. "LED"

DISPLAY BOARD

EPC-G SCHEMATIC

THE OVEN BOARD PROVIDES CONTROL OF OVEN HEATING AND COOLING AND CONTROLS THE INTERNAL TEMPERATURE OF THE G.C. CHASSIS. THIS PAGE DEPICTS THE POWER SUPPLY CIRCUIT, JITTER CIRCUIT AND THE CHASSIS COOLING CIRCUIT. SEE PAGE TWO FOR OVEN HEATING AND COOLING CIRCUITS.

CHASSIS COOLING FAN CIRCUIT

JITTER INPUT (FROM U3 PIN 8 JITTER CIRCUIT SHOWN ON BOTTOM OF THIS PAGE)

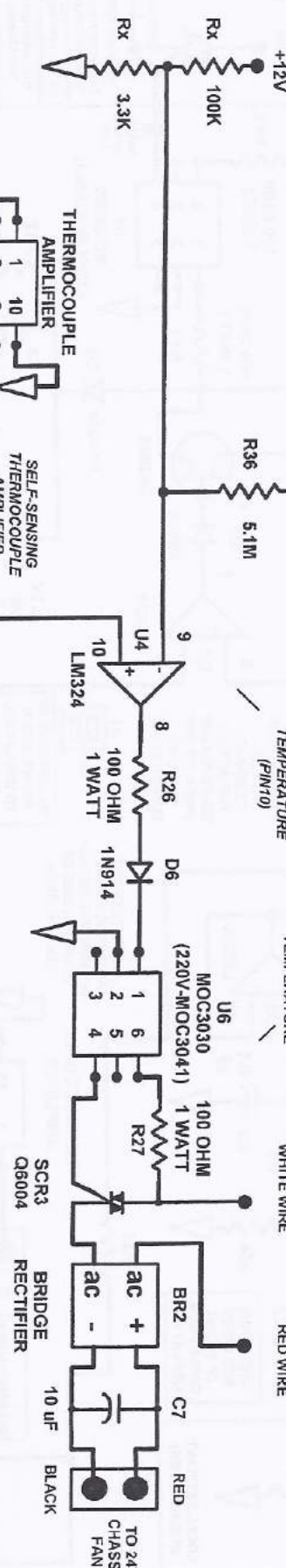
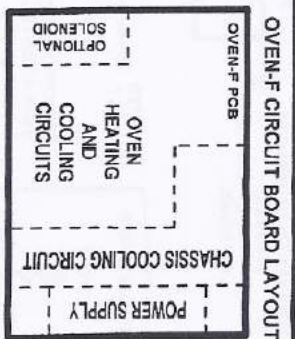
CHASSIS FAN CIRCUIT:
VOLTAGE DIVIDER
DETERMINES FAN ON/OFF
SETPOINT TO COOL
TEMPERATURE IN CHASSIS

COMPARATOR
CIRCUIT:
COMPARES
THE ACTUAL
TEMPERATURE
(PIN 9) TO THE
SETPOINT
TEMPERATURE
(PIN 10)

AC SWITCHING
CIRCUIT:
SWITCHES AC TO
HEATED ZONE TO
ACHIEVE DESIRED
TEMPERATURE

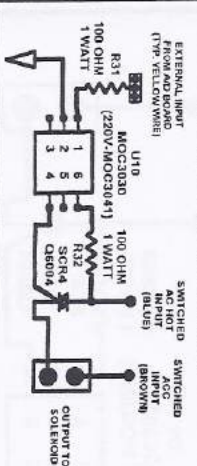
28 VOLTS AC
FROM POWER
SUPPLY SECTION
WHITE WIRE

28 VOLTS AC
FROM POWER
SUPPLY SECTION
RED WIRE

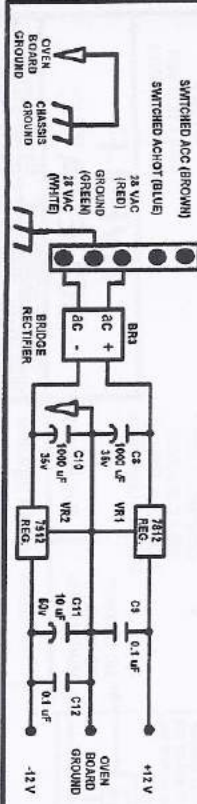


VACUUM PUMP OPTION USES THIS CIRCUIT

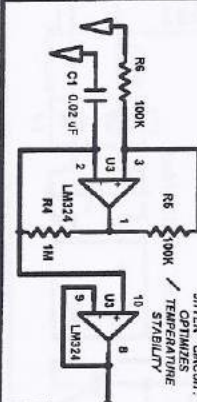
OPTIONAL SOLENOID CIRCUIT



POWER SUPPLY SECTION



JITTER CIRCUIT



THE LM324'S IN THIS CIRCUIT OPERATE USING +12V ON PIN 4 AND -12V ON PIN 11.

CAUTION: ACHOT AND ACCOMMON ARE HAZARDOUS VOLTAGES AND ARE PRESENT ON THIS AND OTHER CIRCUIT BOARDS WHILE THE G.C. POWER IS ON.

OVEN-F SCHEMATIC

Filename: oven-f pg1.tcw

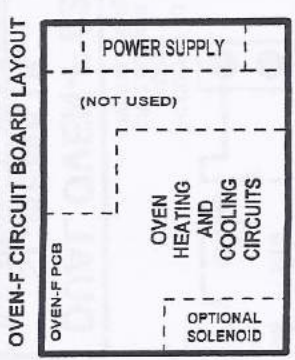
Page 1 of 2

Date: 12/20/97
Rev. Date: 3/09/01
By: R. Fenster
By: R. Pfeiffer

THE DUAL OVEN BOARD #2 PROVIDES CONTROL OF OVEN HEATING AND COOLING. THIS PAGE DEPICTS THE POWER SUPPLY CIRCUIT AND JITTER CIRCUIT.

SEE PAGE TWO FOR OVEN HEATING AND COOLING CIRCUITS.

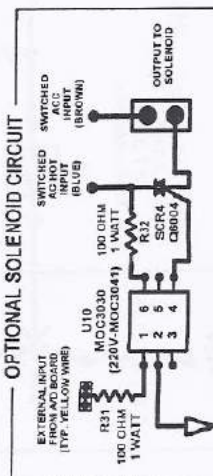
CHASSIS COOLING FAN CIRCUIT (NOT USED)



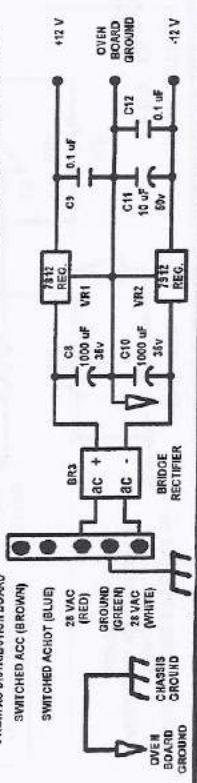
DUAL OVEN CONFIGURATION REQUIRES THE USE OF A STANDARD OVEN PCB FOR OVEN #1 AND A SECOND OVEN PCB WITHOUT THE CHASSIS COOLING FAN CIRCUIT FOR OVEN #2. IF NECESSARY, A STANDARD OVEN BOARD MAYBE USED FOR OVEN #2, PROVIDED THAT THE CHASSIS COOLING CIRCUIT IS LEFT UN-USED. OVEN-F #2 IS THE SCHEMATIC DIAGRAM FOR THE OVEN BOARD WITHOUT THE CHASSIS COOLING CIRCUIT; AS USED FOR THE SECOND OVEN IN A DUAL OVEN CONFIGURATION.

CAUTION: ACHOT AND ACC ARE HAZARDOUS VOLTAGES AND ARE PRESENT ON THIS AND OTHER CIRCUIT BOARDS WHILE THE G.C. POWER IS ON.

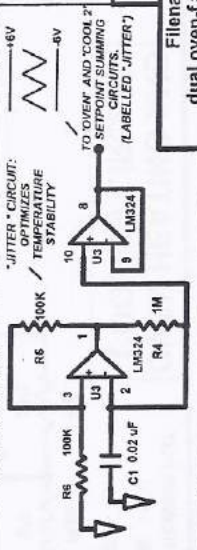
VACUUM PUMP OPTION USES THIS CIRCUIT



POWER SUPPLY SECTION



JITTER CIRCUIT

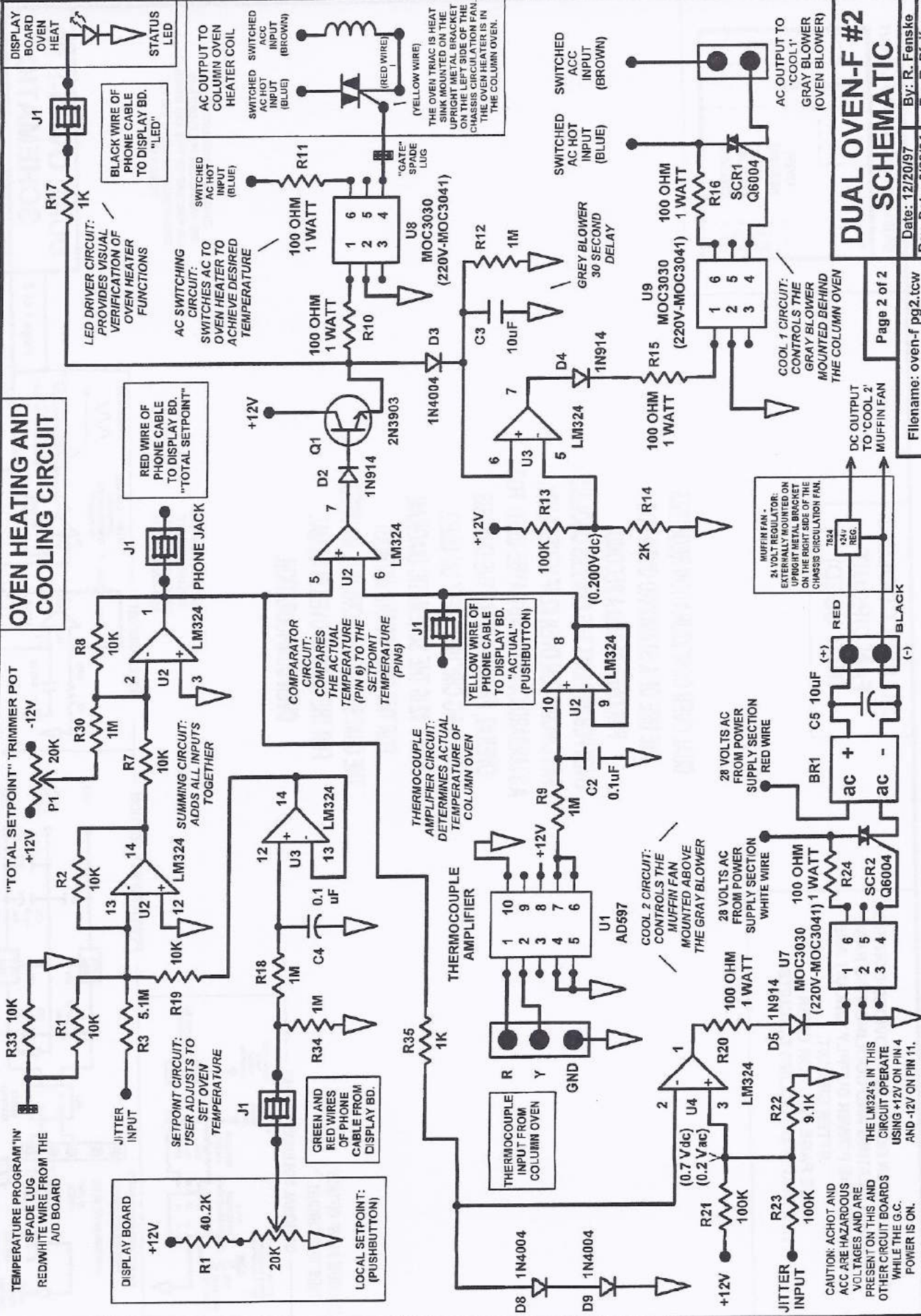


THE LM324's IN THIS CIRCUIT OPERATE USING +12V ON PIN 4 AND -12V ON PIN 11.

DUAL OVEN-F #2 SCHEMATIC

Date: 3/02/01
Rev. Date: By: R. Pfeifer

OVEN HEATING AND COOLING CIRCUIT



DUAL OVEN-F #2 SCHEMATIC

Date: 12/20/97
Rev. Date: 3/05/01

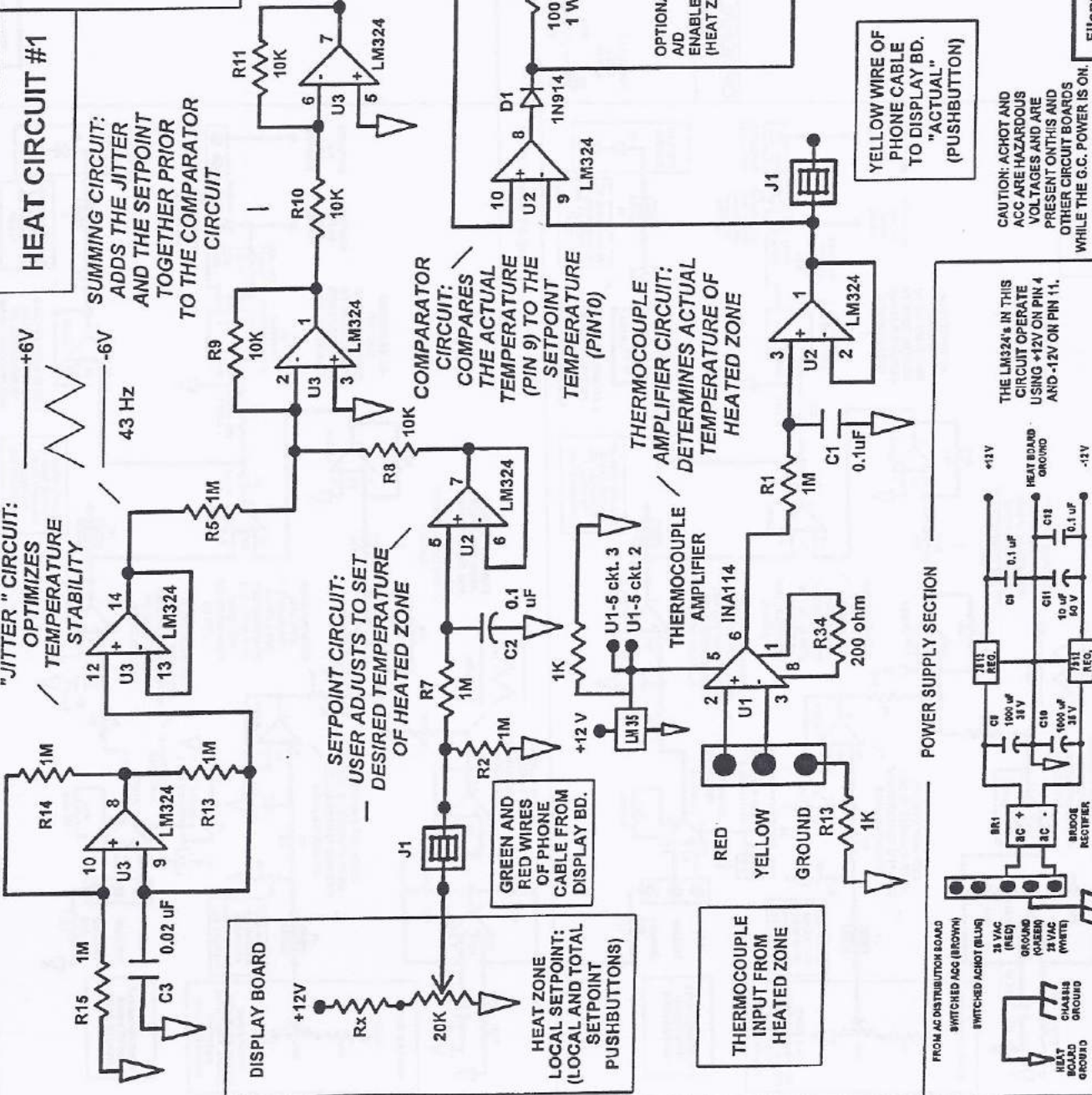
By: R. Fenske
By: R. Pfeifer

Filename: oven-f pg2.tcv

Page 2 of 2

HEAT CIRCUIT #1

THE HEAT BOARD PROVIDES TEMPERATURE CONTROL OF HEATED ZONES IN THE G.C. (ie TCD BLOCK; HEATED INJECTOR; ETC.). EACH HEAT BOARD CONTAINS UP TO THREE TEMPERATURE CONTROL CIRCUITS. THIS PAGE DEPICTS THE SCHEMATIC OF HEAT CIRCUIT #1. SEE THE NEXT PAGE FOR HEAT CIRCUITS #2 AND #3.



HEAT-G SCHEMATIC

Page 1 of 2

Filename: heat-g pg1.icw

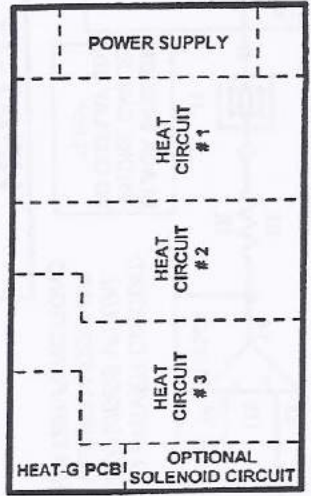
Date: 12/20/97

Rev. Date: 4/12/02

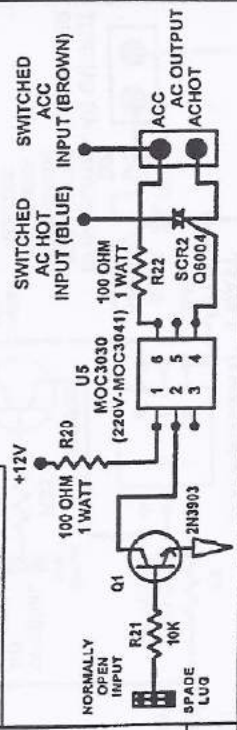
By: R. Fenske

By: M. WATTS

HEAT-G CIRCUIT BOARD LAYOUT



OPTIONAL SOLENOID CIRCUIT



THIS PAGE DEPICTS THE SCHEMATICS OF HEAT CIRCUITS #2 AND #3 AND OF THE OPTIONAL SOLENOID CIRCUIT. THE DIFFERENCES BETWEEN HEAT CIRCUITS #1, #2 AND #3 ARE:

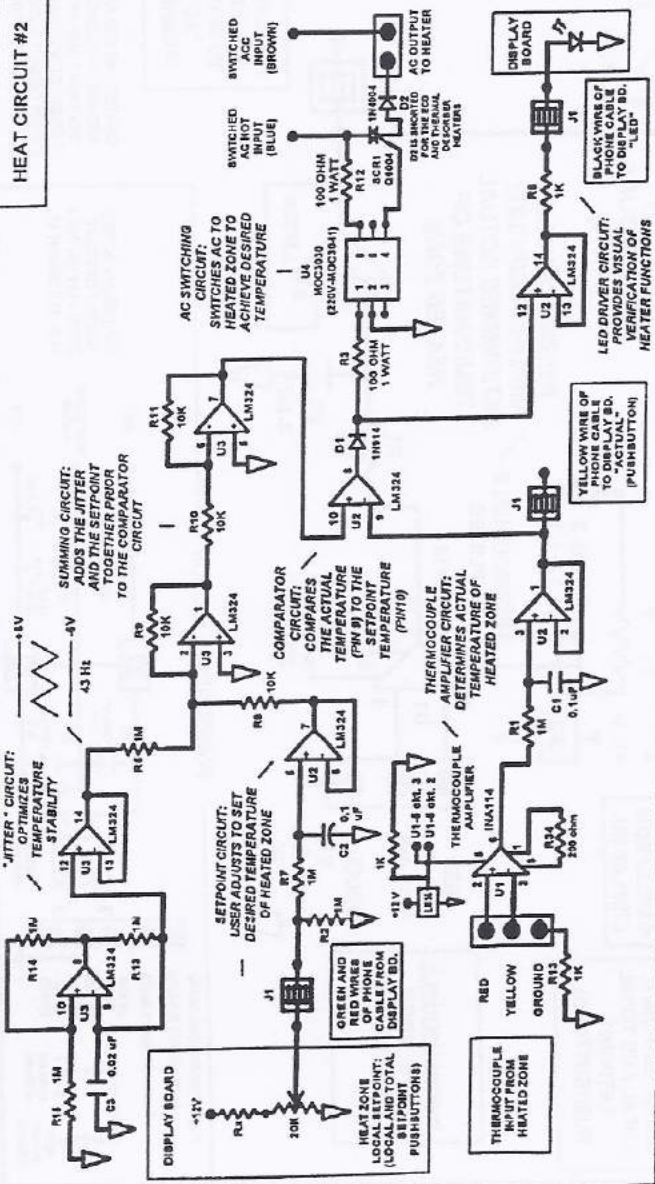
- CIRCUIT #1 HAS AN OPTIONAL A/D ENABLE OF THE HEAT ZONE AND AN OPTIONAL GATE SIGNAL INPUT FOR AN EXTERNAL TRIAC.
- ALSO, THE SUMMING CIRCUIT IN EACH HAVE DIFFERENT OP-AMP PINOUTS: HEAT CIRCUIT #1 USES U3 PIN 1 AND PIN 7 OUTPUTS.
- HEAT CIRCUIT #2 USES U5 PIN 1 AND PIN 7 OUTPUTS.
- HEAT CIRCUIT #3 USES U5 PIN 14 AND PIN 8 OUTPUTS.

HEAT-G SCHEMATIC

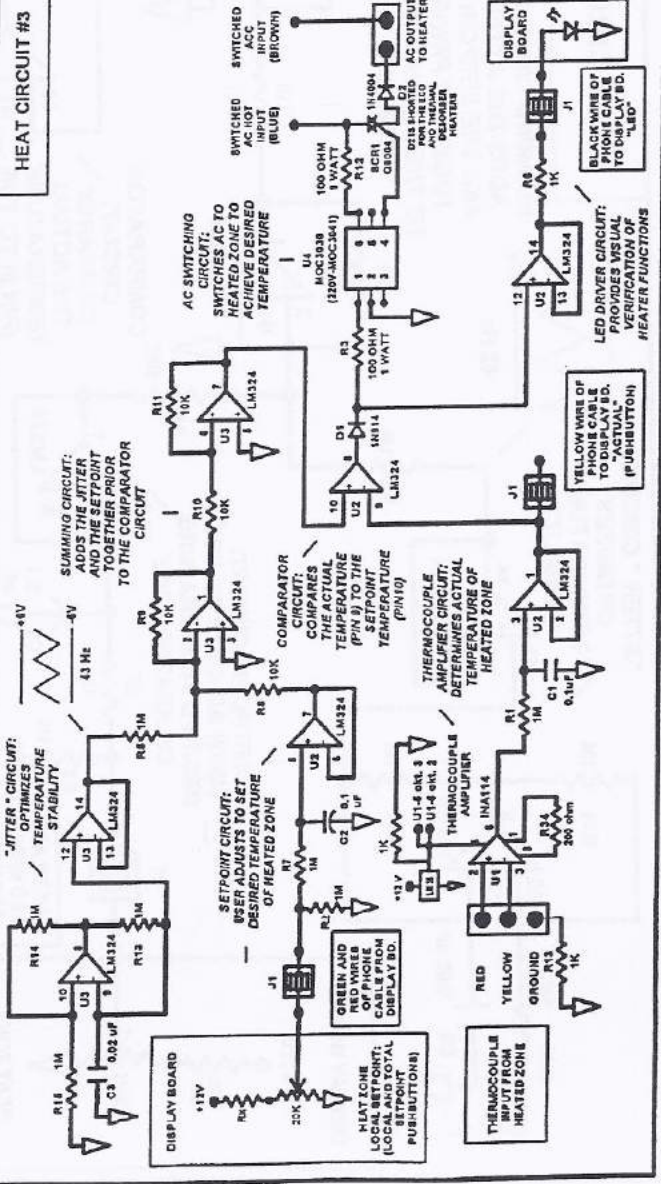
Date: 12/20/97
Rev. Date: 4/12/02
By: R. Fenske
By: M. WATTS

Page 2 of 2
Filename: heat-g pg2.tcw

HEAT CIRCUIT #2



HEAT CIRCUIT #3



Page 2 of 2

TRAP #1 CIRCUIT OF PURGE & TRAP BOARD

AC SWITCHING CIRCUIT: SWITCHES AC TO TRAP HEATER TO ACHIEVE DESIRED TEMPERATURE

SWITCHED AC HOT INPUT (BLUE)

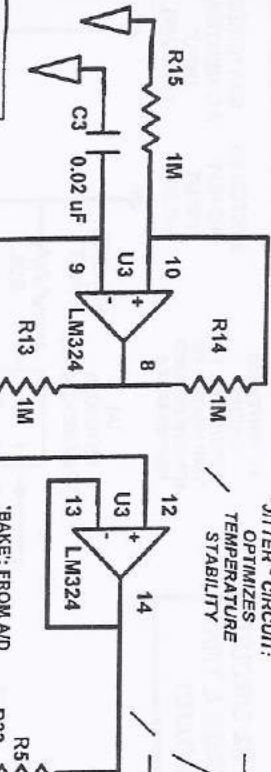
SWITCHED AC NEUTRAL INPUT (BROWN)

43 Hz

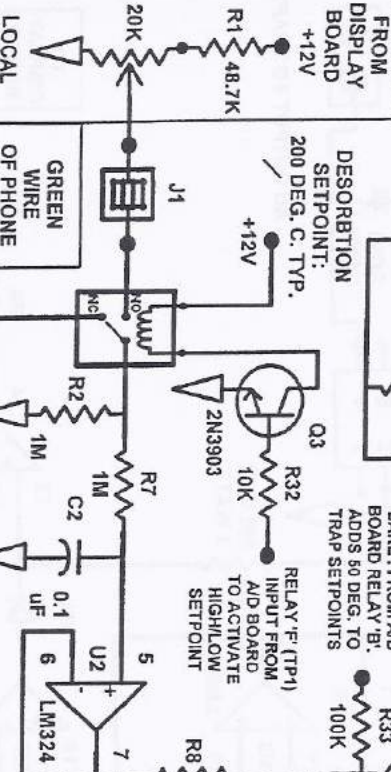
+6V

-6V

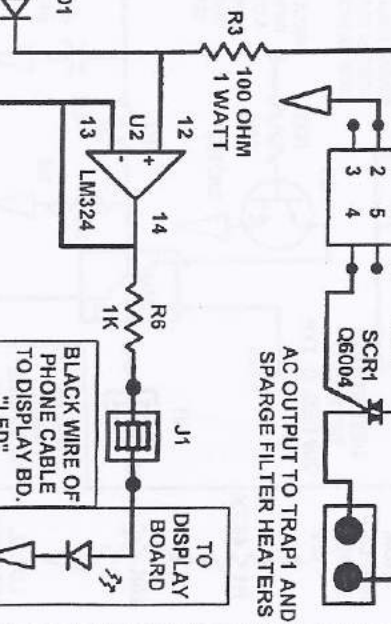
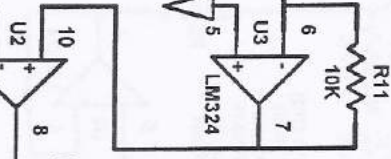
JITTER CIRCUIT: OPTIMIZES TEMPERATURE STABILITY



SUMMING CIRCUIT: ADDS THE JITTER AND THE SETPOINT TOGETHER PRIOR TO THE COMPARATOR CIRCUIT

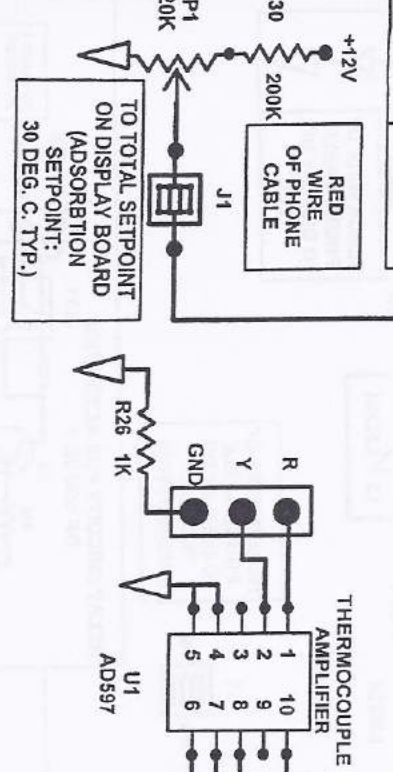


COMPARATOR CIRCUIT: COMPARES THE ACTUAL TEMPERATURE (PIN 9) TO THE SETPOINT (PIN10)

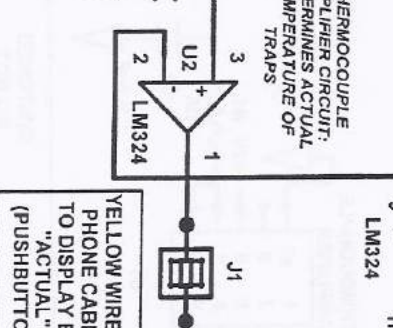


TO DISPLAY BOARD

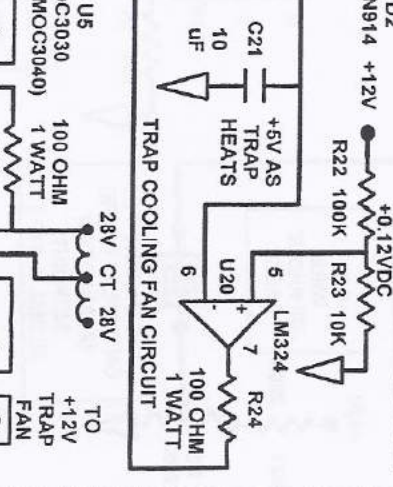
BLACK WIRE OF PHONE CABLE TO DISPLAY BD. "LED"



THERMOCOUPLE AMPLIFIER CIRCUIT: DETERMINES ACTUAL TEMPERATURE OF TRAPS



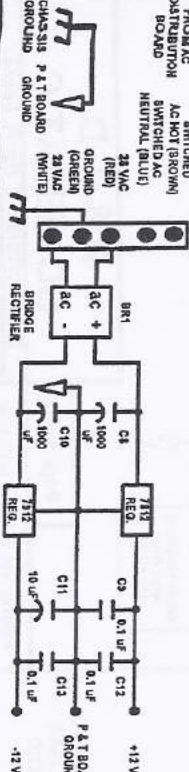
YELLOW WIRE OF PHONE CABLE TO DISPLAY BD. "ACTUAL" (PUSHBUTTON)



TO TRAP FAN

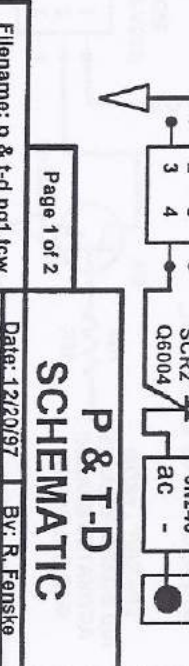
TO DISPLAY BOARD

POWER SUPPLY SECTION



THE LM324's IN THIS CIRCUIT OPERATE USING +12V ON PIN 4 AND -12V ON PIN 11.

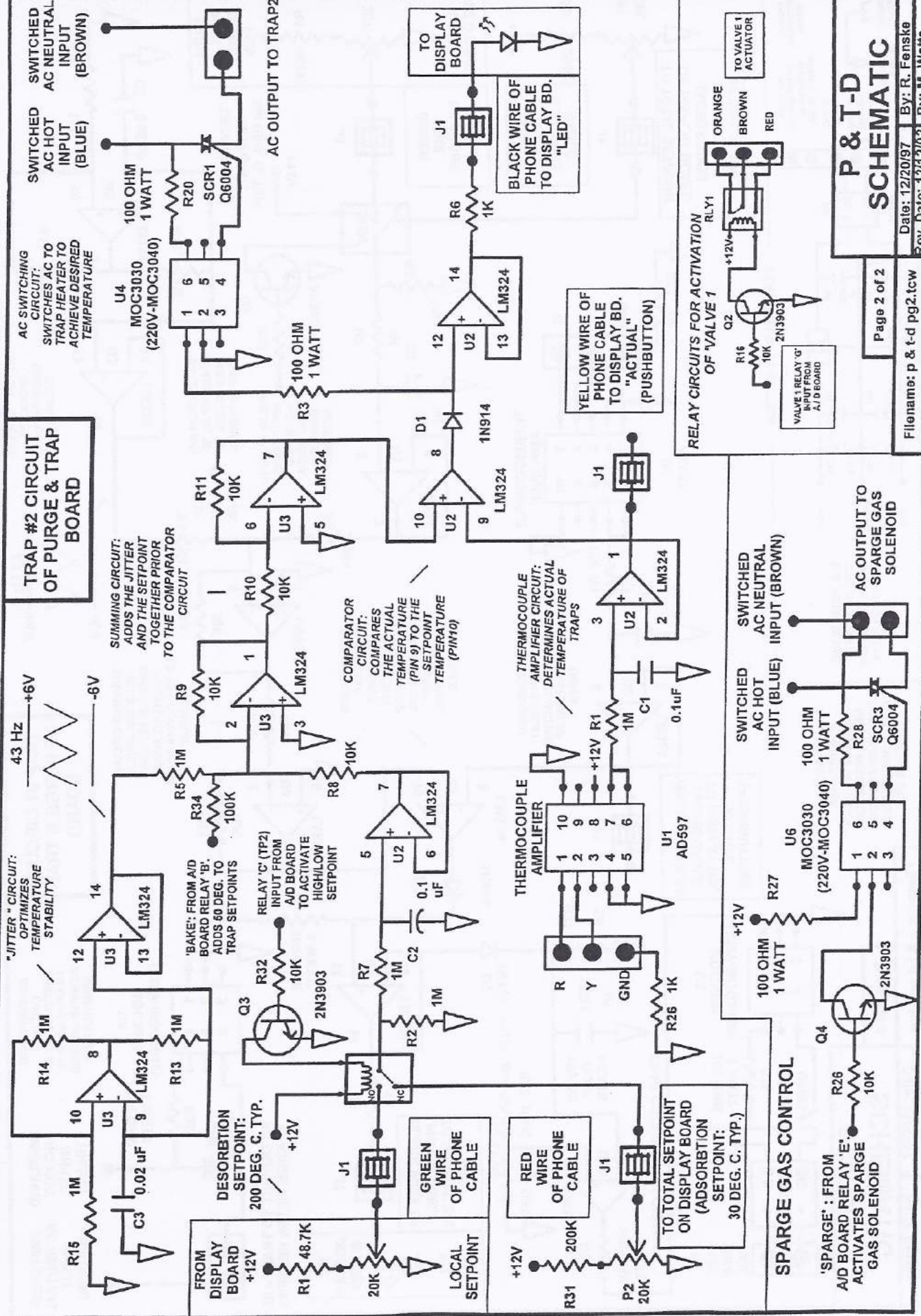
CAUTION: ACHOT AND AGNEUTRAL ARE HAZARDOUS VOLTAGES AND ARE PRESENT ON THIS AND OTHER CIRCUIT BOARDS WHILE THE G.C. POWER IS ON.



TO TRAP FAN

TO DISPLAY BOARD

TRAP #2 CIRCUIT OF PURGE & TRAP BOARD



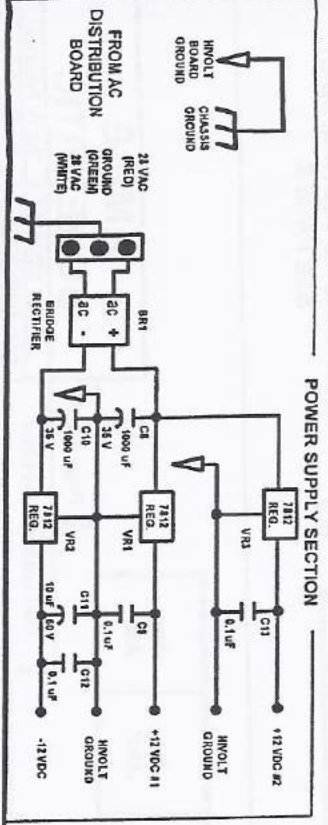
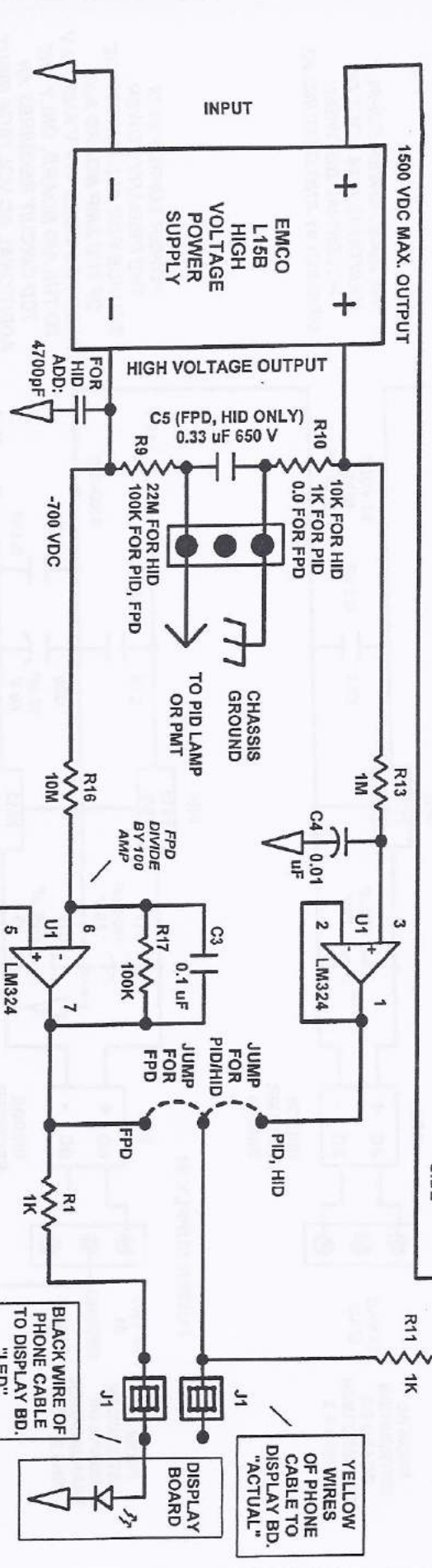
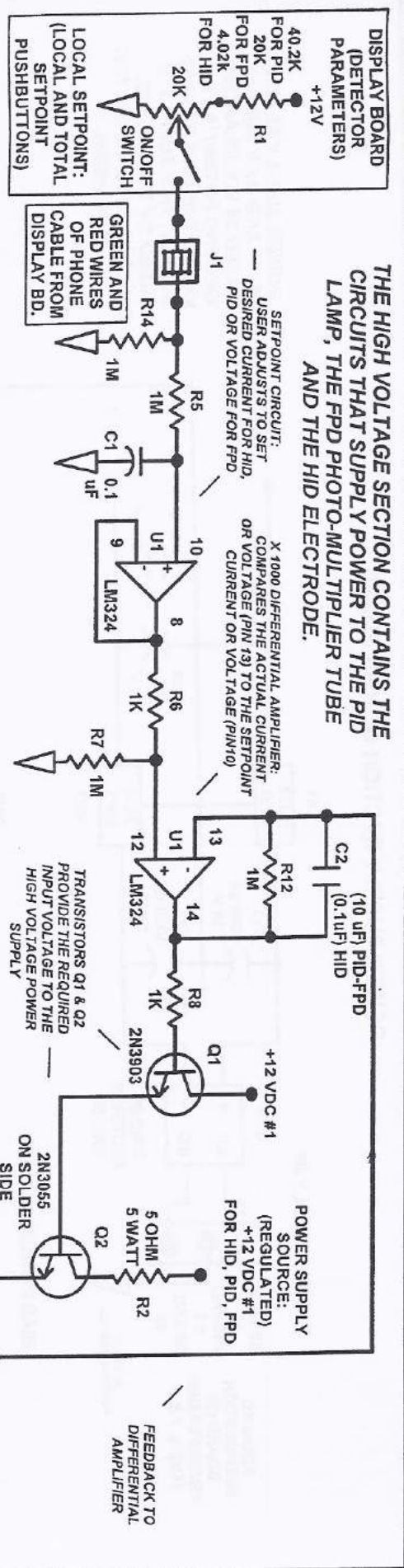
P & T-D SCHEMATIC

Date: 12/20/97 By: R. Fenske
Rev. Date: 12/12/02 By: M. Watts

Page 2 of 2

Filename: p & t-d pg2.tcw

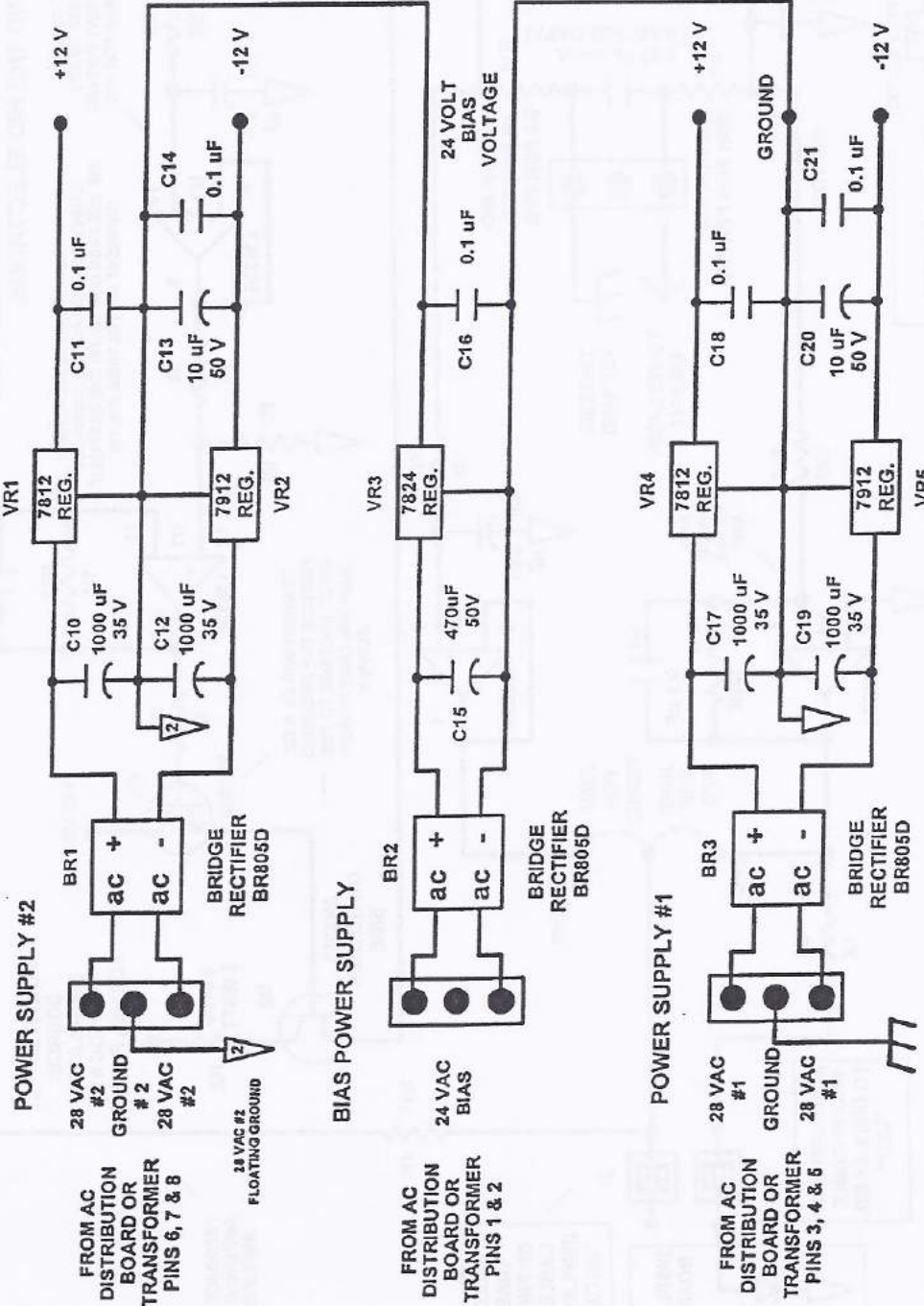
THE HIGH VOLTAGE SECTION CONTAINS THE CIRCUITS THAT SUPPLY POWER TO THE PID LAMP, THE FPD PHOTO-MULTIPLIER TUBE AND THE HID ELECTRODE.



(U1) AMPLIFIER FOR PID OR FPD IS: LM324 FOR HID: LF347

THE LM324 AND THE LF347 IN THIS CIRCUIT OPERATE USING +12V ON PIN 4, AND -12V ON PIN 11.

POWER SUPPLY SECTION OF AMP BOARD



POWER SUPPLY #2 IS A +12 V AND -12 V SUPPLY BIASED 24 VOLTS ABOVE GROUND POTENTIAL BY VR3 OF THE BIAS POWER SUPPLY. THIS SUPPLY IS USED BY THE FID, PID, DELCD AND FPD DETECTOR AMPLIFIERS.

THE BIAS POWER SUPPLY MAINTAINS A 24 VOLT DC POTENTIAL BETWEEN GROUND #1 AND GROUND #2.

POWER SUPPLY #1 IS THE PRIMARY POWER SOURCE FOR ALL FUNCTIONS OF THE AMP BOARD AND ALSO PROVIDES +12 V AND -12 V TO THE A/D BOARD. ONLY THE TCD CIRCUIT REQUIRES AN ADDITIONAL AC VOLTAGE INPUT. SEE PAGE 2.

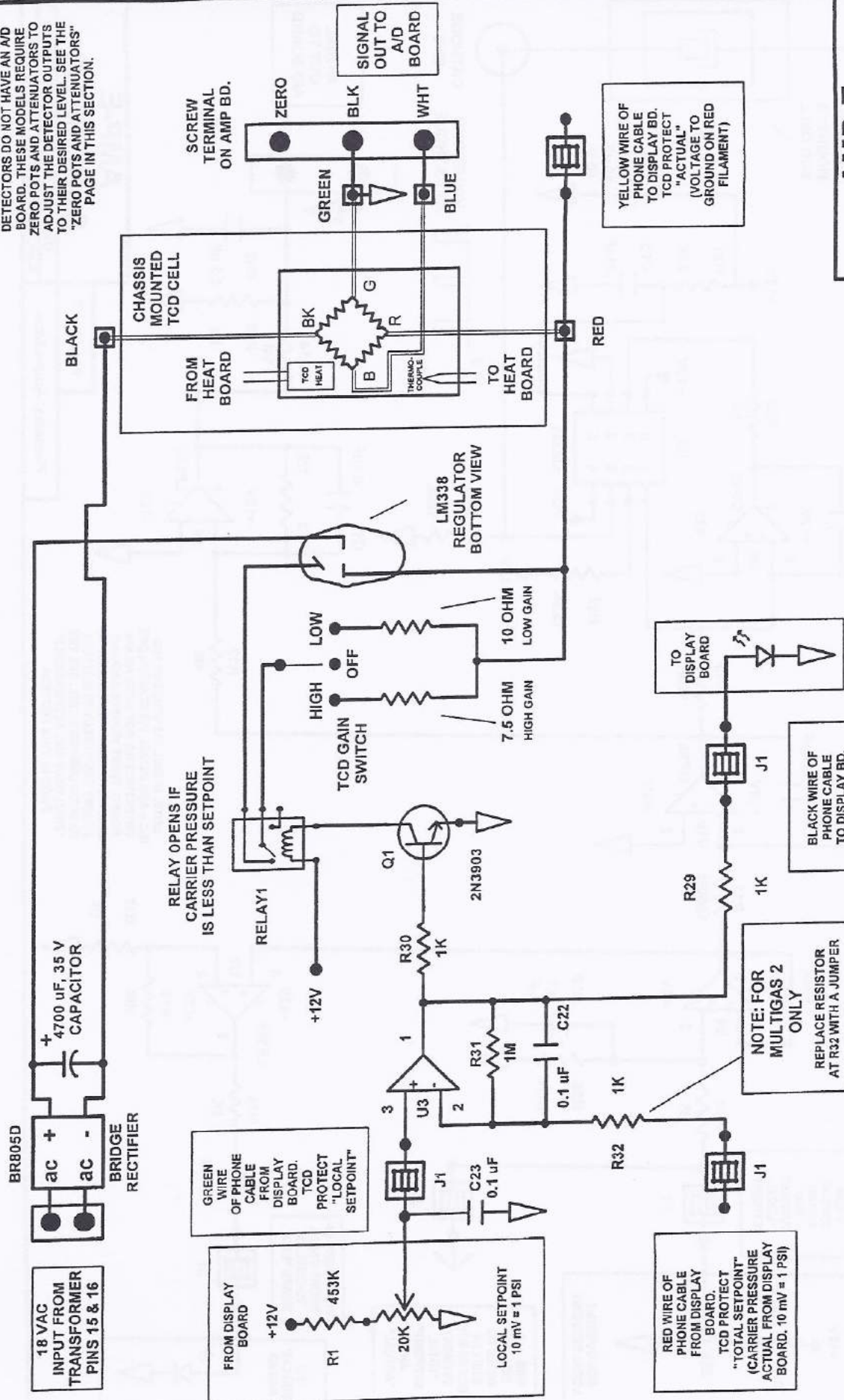
AMPLIFIER BOARD LAYOUT



AMP-E SCHEMATIC

TCD SECTION OF AMPLIFIER BOARD

NOTE: MODEL 310 STUDENT TCD G.C.s AND MODEL 110 STANDALONE DETECTORS DO NOT HAVE AN A/D BOARD. THESE MODELS REQUIRE ZERO POTS AND ATTENUATORS TO ADJUST THE DETECTOR OUTPUTS TO THEIR DESIRED LEVEL. SEE THE "ZERO POTS AND ATTENUATORS" PAGE IN THIS SECTION.

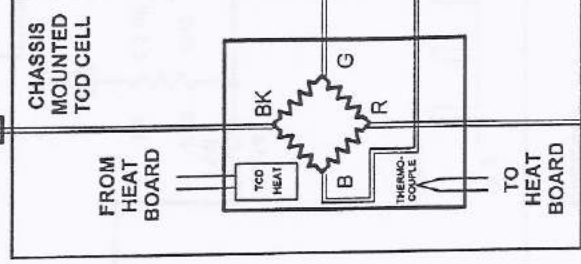


BR805D

18 VAC INPUT TRANSFORMER PINS 15 & 16

BRIDGE RECTIFIER

BLACK



RELAY OPENS IF CARRIER PRESSURE IS LESS THAN SETPOINT

GREEN WIRE OF PHONE CABLE FROM DISPLAY BOARD. TCD PROTECT "LOCAL SETPOINT"

FROM DISPLAY BOARD +12V

R1 453K

20K

LOCAL SETPOINT 10 mV = 1 PSI

LOW

HIGH

OFF

TCD GAIN SWITCH

RELAY1

+12V

R30 1K

Q1 2N3903

U3

R31 1M

C22 0.1 uF

R32 1K

J1

J1

R29 1K

TO HEAT BOARD

CHASSIS MOUNTED TCD CELL

FROM HEAT BOARD

TCD HEAT

BK

G

R

TO HEAT BOARD

THERMOCOUPLE

B

GREEN

BLK

WHT

SIGNAL OUT TO A/D BOARD

ZERO

RED

YELLOW WIRE OF PHONE CABLE TO DISPLAY BD. TCD PROTECT "ACTUAL" (VOLTAGE TO GROUND ON RED FILAMENT)

BLACK WIRE OF PHONE CABLE TO DISPLAY BD. "TCD PROTECT LED"

NOTE: FOR MULTIGAS 2 ONLY REPLACE RESISTOR AT R32 WITH A JUMPER

RED WIRE OF PHONE CABLE FROM DISPLAY BOARD. "TOTAL SETPOINT" (CARRIER PRESSURE ACTUAL FROM DISPLAY BOARD. 10 mV = 1 PSI)

LM338 REGULATOR BOTTOM VIEW

10 OHM LOW GAIN

7.5 OHM HIGH GAIN

TO DISPLAY BOARD

J1

R29 1K

J1

TO DISPLAY BOARD

FILENAME: Amp-e2.tcw

DATE: 12/20/97

BY: R. Fenske

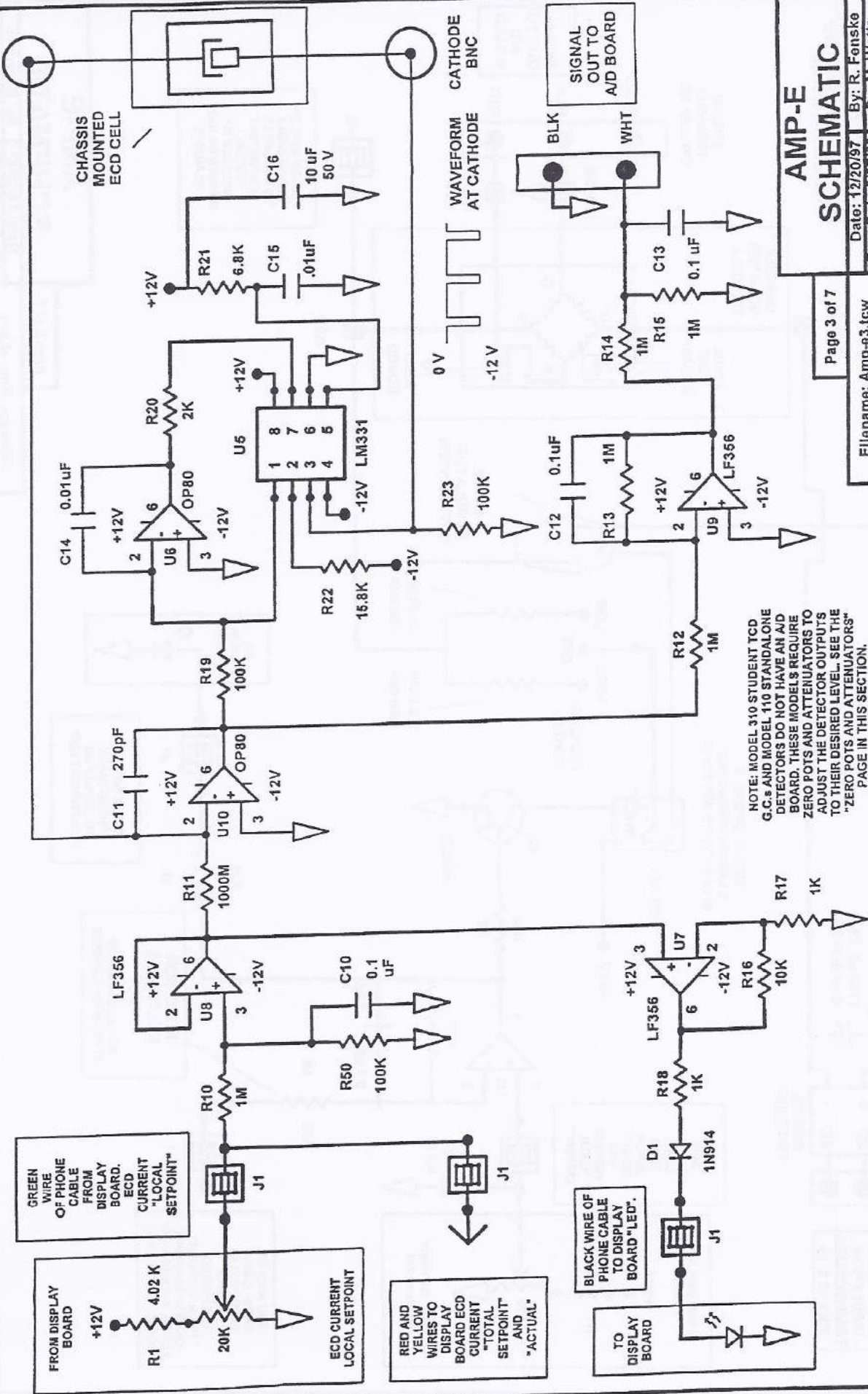
REV. DATE: 9/27/02

BY: M. Watts

PAGE 2 OF 7

AMP-E SCHEMATIC

ECD CURRENT SECTION OF AMP BOARD

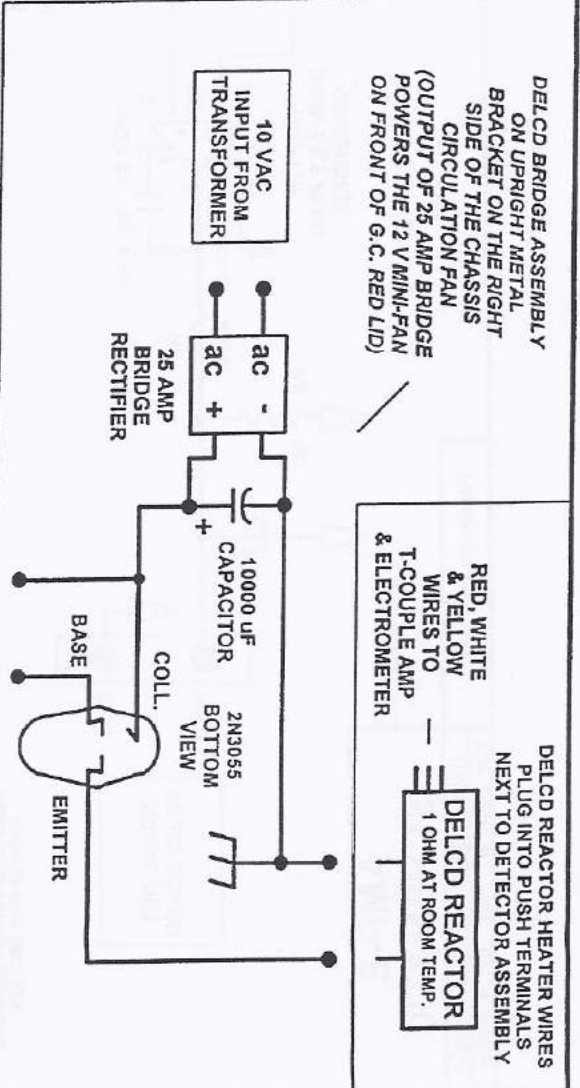


NOTE: MODEL 310 STUDENT TCD G.C.s AND MODEL 110 STANDALONE DETECTORS DO NOT HAVE AN AID BOARD. THESE MODEL'S REQUIRE ZERO POTS AND ATTENUATORS TO ADJUST THE DETECTOR OUTPUTS TO THEIR DESIRED LEVEL. SEE THE "ZERO POTS AND ATTENUATORS" PAGE IN THIS SECTION.

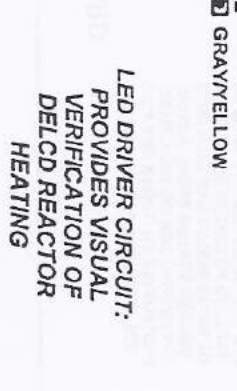
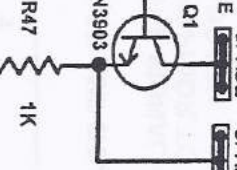
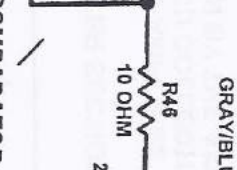
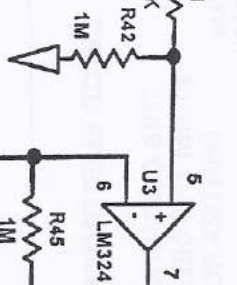
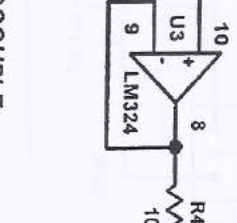
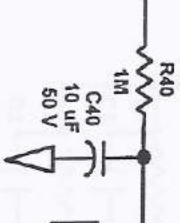
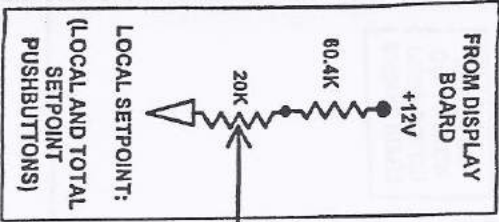
AMP-E SCHEMATIC

DELCD POWER SECTION OF AMP BOARD

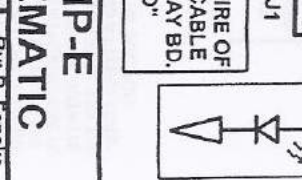
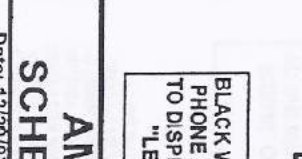
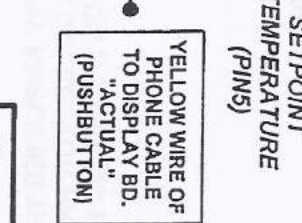
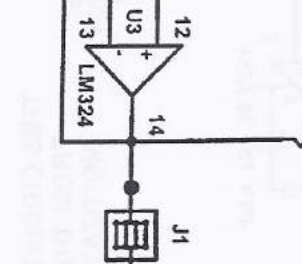
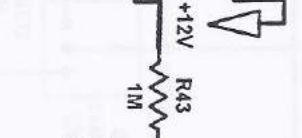
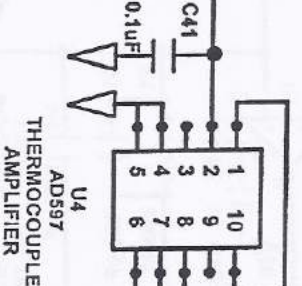
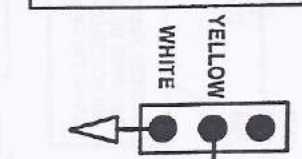
THIS CIRCUITRY CONTROLS THE TEMPERATURE OF THE DELCD REACTOR. SEE PAGE 5 FOR THE DELCD ELECTROMETER SCHEMATIC. THE DELCD REACTOR IS LOCATED ON THE RIGHT SIDE OF THE COLUMN OVEN.

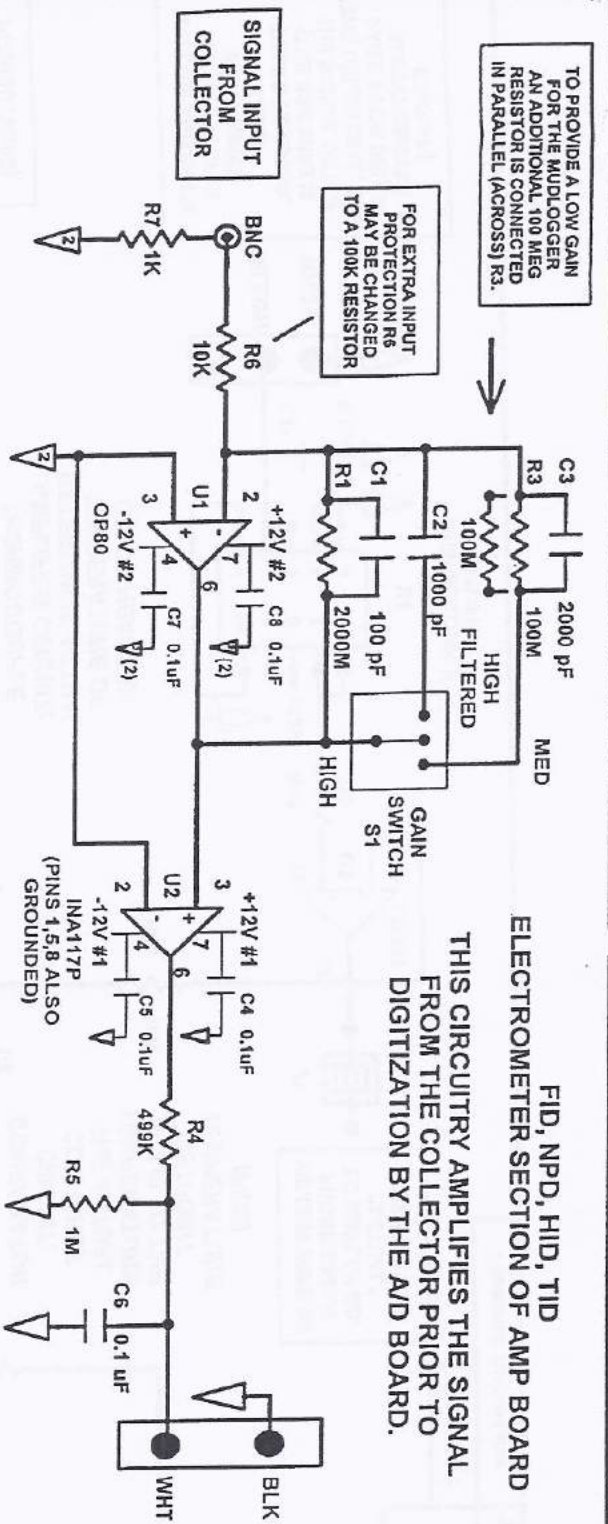


SETPOINT CIRCUIT: USER ADJUSTS TO SET DESIRED TEMPERATURE OF DELCD REACTOR



THERMOCOUPLE AMPLIFIER CIRCUIT: DETERMINES ACTUAL TEMPERATURE OF DELCD REACTOR





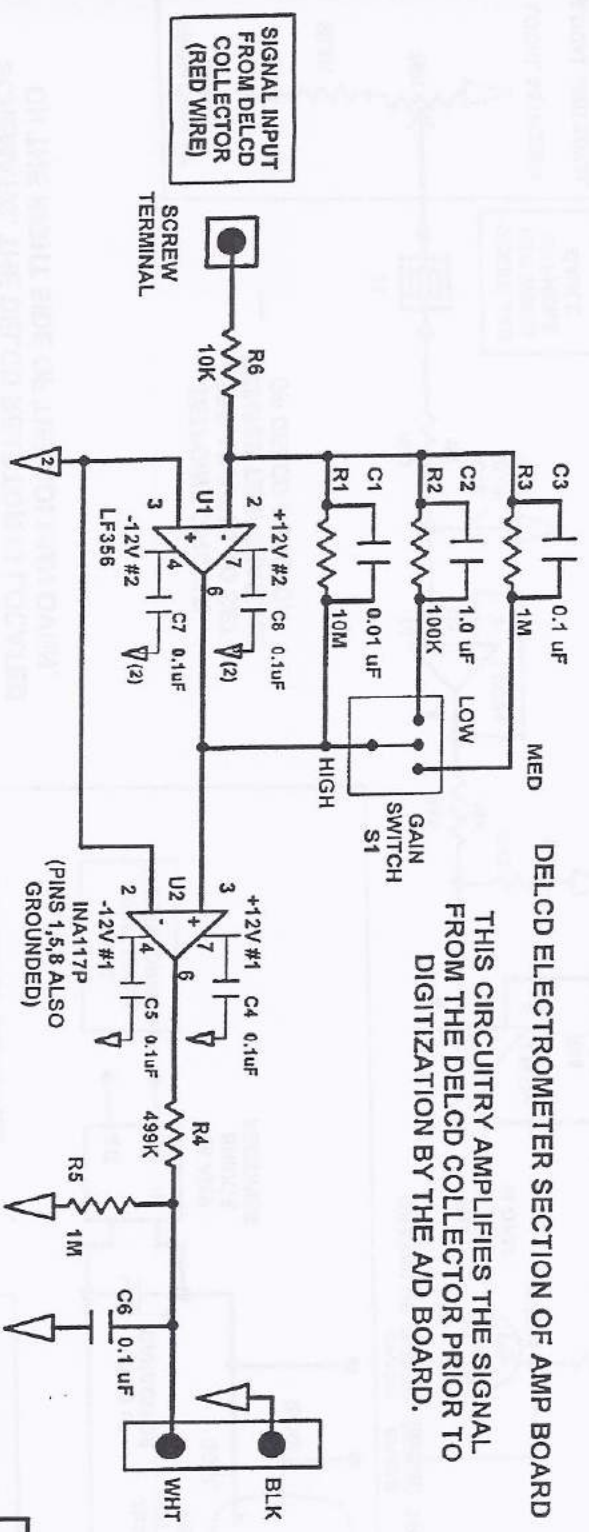
TO PROVIDE A LOW GAIN FOR THE MUDLOGGER AN ADDITIONAL 100 MEG RESISTOR IS CONNECTED IN PARALLEL (ACROSS) R3.

FOR EXTRA INPUT PROTECTION R6 MAY BE CHANGED TO A 100K RESISTOR

FID, NPD, HID, TID ELECTROMETER SECTION OF AMP BOARD

THIS CIRCUITRY AMPLIFIES THE SIGNAL FROM THE COLLECTOR PRIOR TO DIGITIZATION BY THE A/D BOARD.

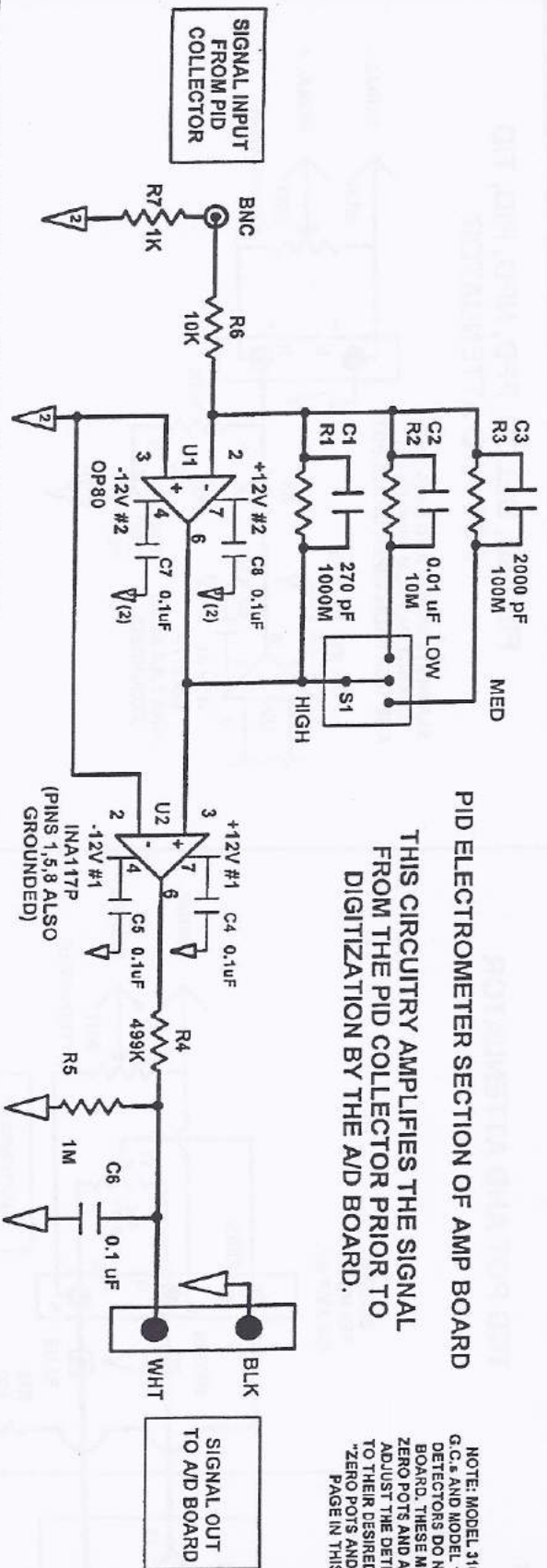
NOTE: MODEL 310 STUDENT TCD G.C.s AND MODEL 110 STANDALONE DETECTORS DO NOT HAVE AN A/D BOARD. THESE MODELS REQUIRE ZERO POTS AND ATTENUATORS TO ADJUST THE DETECTOR OUTPUTS TO THEIR DESIRED LEVEL. SEE THE "ZERO POTS AND ATTENUATORS" PAGE IN THIS SECTION.



DELCD ELECTROMETER SECTION OF AMP BOARD

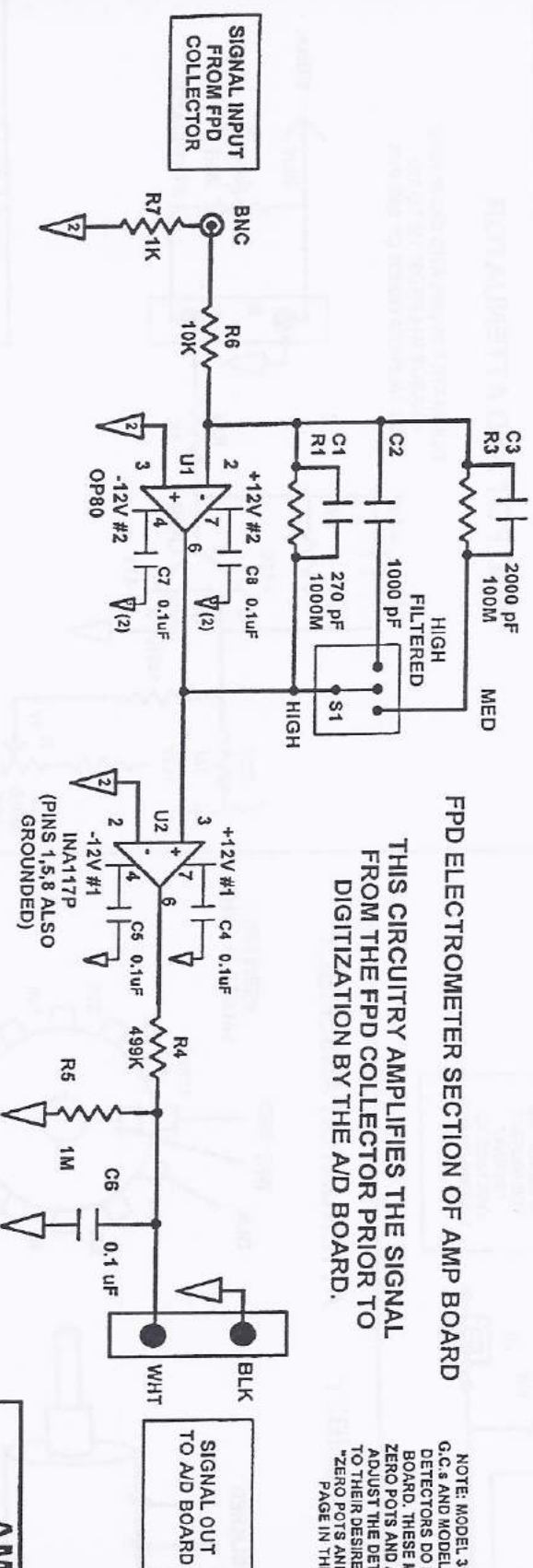
THIS CIRCUITRY AMPLIFIES THE SIGNAL FROM THE DELCD COLLECTOR PRIOR TO DIGITIZATION BY THE A/D BOARD.

NOTE: MODEL 310 STUDENT TCD G.C.s AND MODEL 110 STANDALONE DETECTORS DO NOT HAVE AN A/D BOARD. THESE MODELS REQUIRE ZERO POTS AND ATTENUATORS TO ADJUST THE DETECTOR OUTPUTS TO THEIR DESIRED LEVEL. SEE THE "ZERO POTS AND ATTENUATORS" PAGE IN THIS SECTION.



PID ELECTROMETER SECTION OF AMP BOARD
 THIS CIRCUITRY AMPLIFIES THE SIGNAL FROM THE PID COLLECTOR PRIOR TO DIGITIZATION BY THE A/D BOARD.

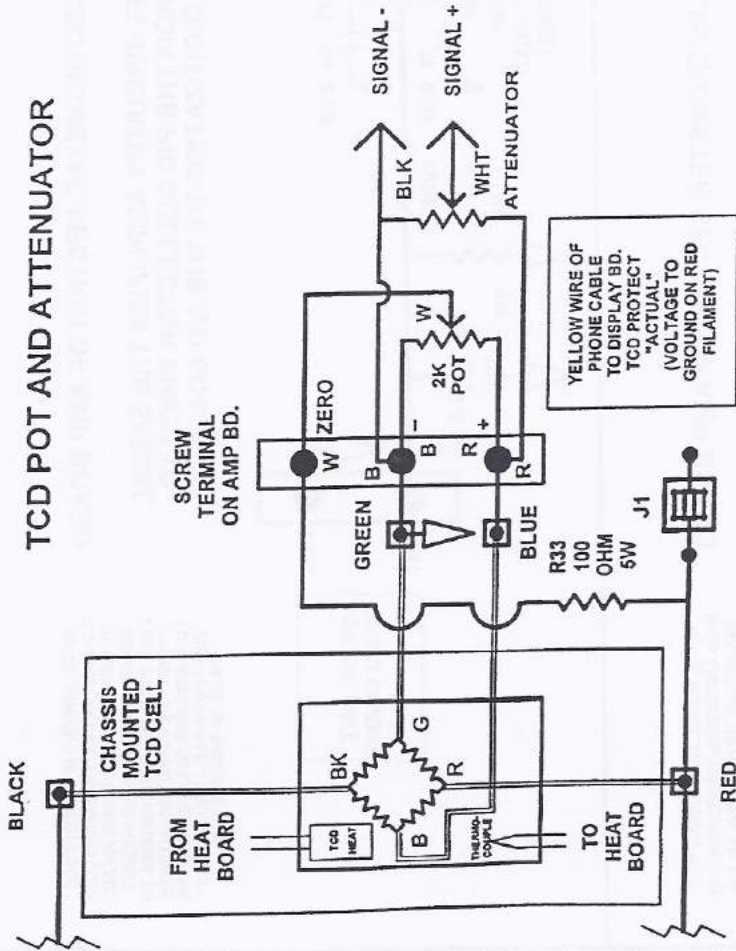
NOTE: MODEL 310 STUDENT TCD G.C.s AND MODEL 110 STANDALONE DETECTORS DO NOT HAVE AN A/D BOARD. THESE MODELS REQUIRE ZERO POTS AND ATTENUATORS TO ADJUST THE DETECTOR OUTPUTS TO THEIR DESIRED LEVEL. SEE THE "ZERO POTS AND ATTENUATORS" PAGE IN THIS SECTION.



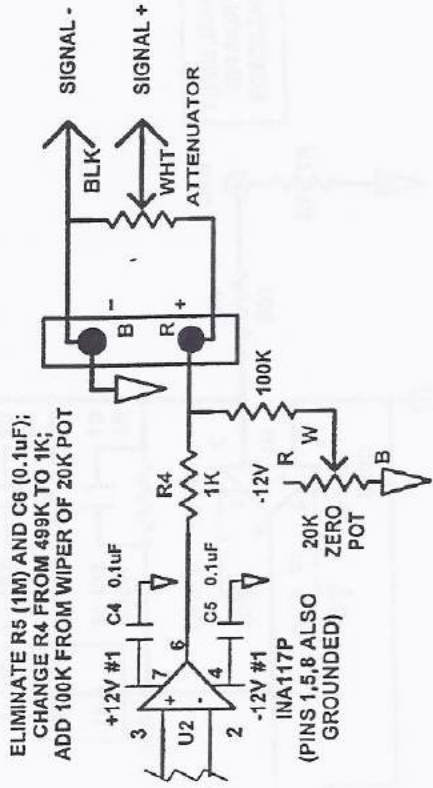
FPD ELECTROMETER SECTION OF AMP BOARD
 THIS CIRCUITRY AMPLIFIES THE SIGNAL FROM THE FPD COLLECTOR PRIOR TO DIGITIZATION BY THE A/D BOARD.

NOTE: MODEL 310 STUDENT TCD G.C.s AND MODEL 110 STANDALONE DETECTORS DO NOT HAVE AN A/D BOARD. THESE MODELS REQUIRE ZERO POTS AND ATTENUATORS TO ADJUST THE DETECTOR OUTPUTS TO THEIR DESIRED LEVEL. SEE THE "ZERO POTS AND ATTENUATORS" PAGE IN THIS SECTION.

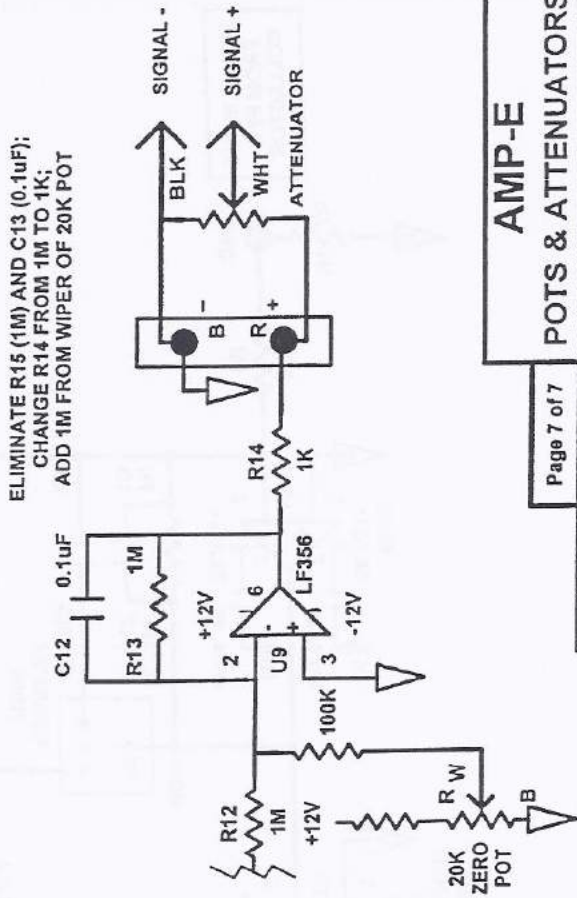
TCD POT AND ATTENUATOR



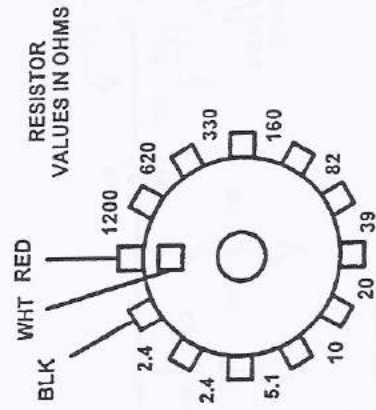
FID, PID, DELCD, FPD, NPD, HID, TID POT AND ATTENUATOR



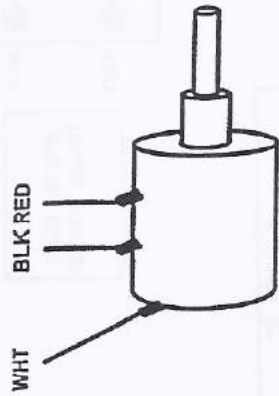
ECD POT AND ATTENUATOR



ATTENUATOR ASSEMBLY

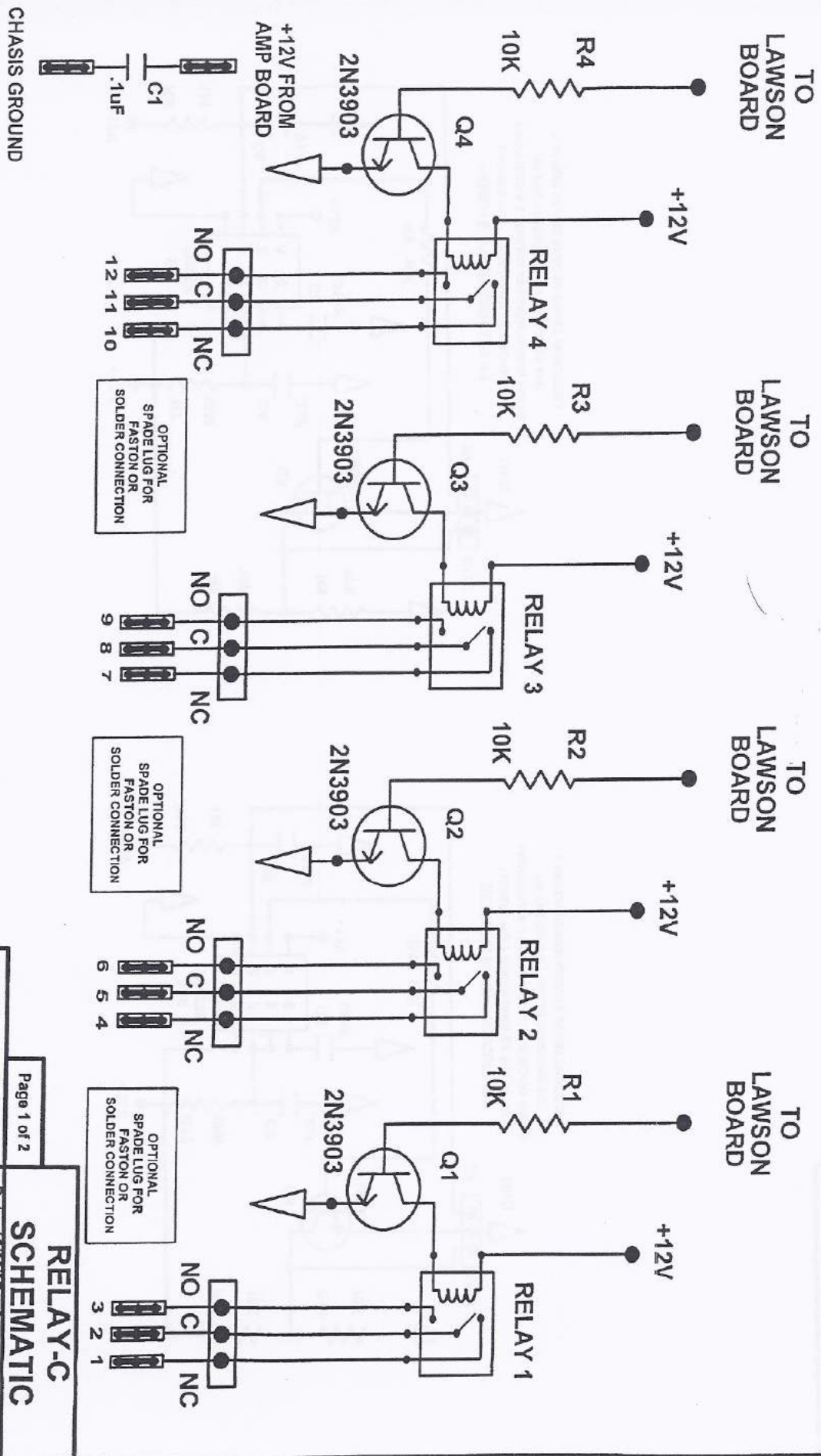


ZERO POT ASSEMBLY



TCD: 2K POT
ALL OTHERS: 20K POT

ACCESSORY RELAY BOARD (1-4 RELAYS) WITH EXTERNAL CONNECTOR



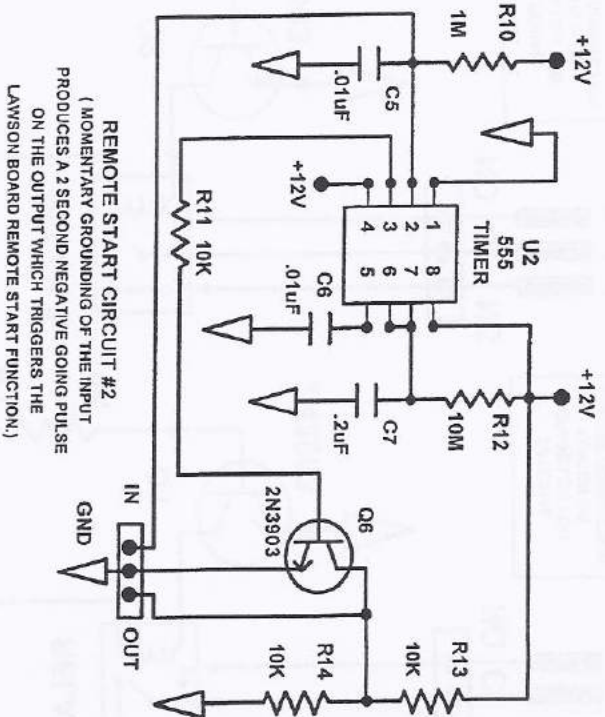
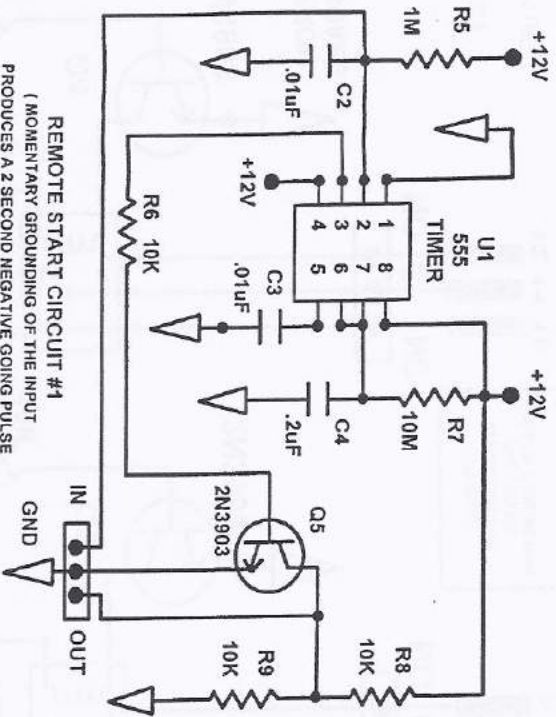
CHASSIS GROUND

RELAY-C SCHEMATIC
 Date: 12/20/97
 By: R. Egnstke
 REV. DATE: 12/13/02
 By: M. WATTS

Page 1 of 2

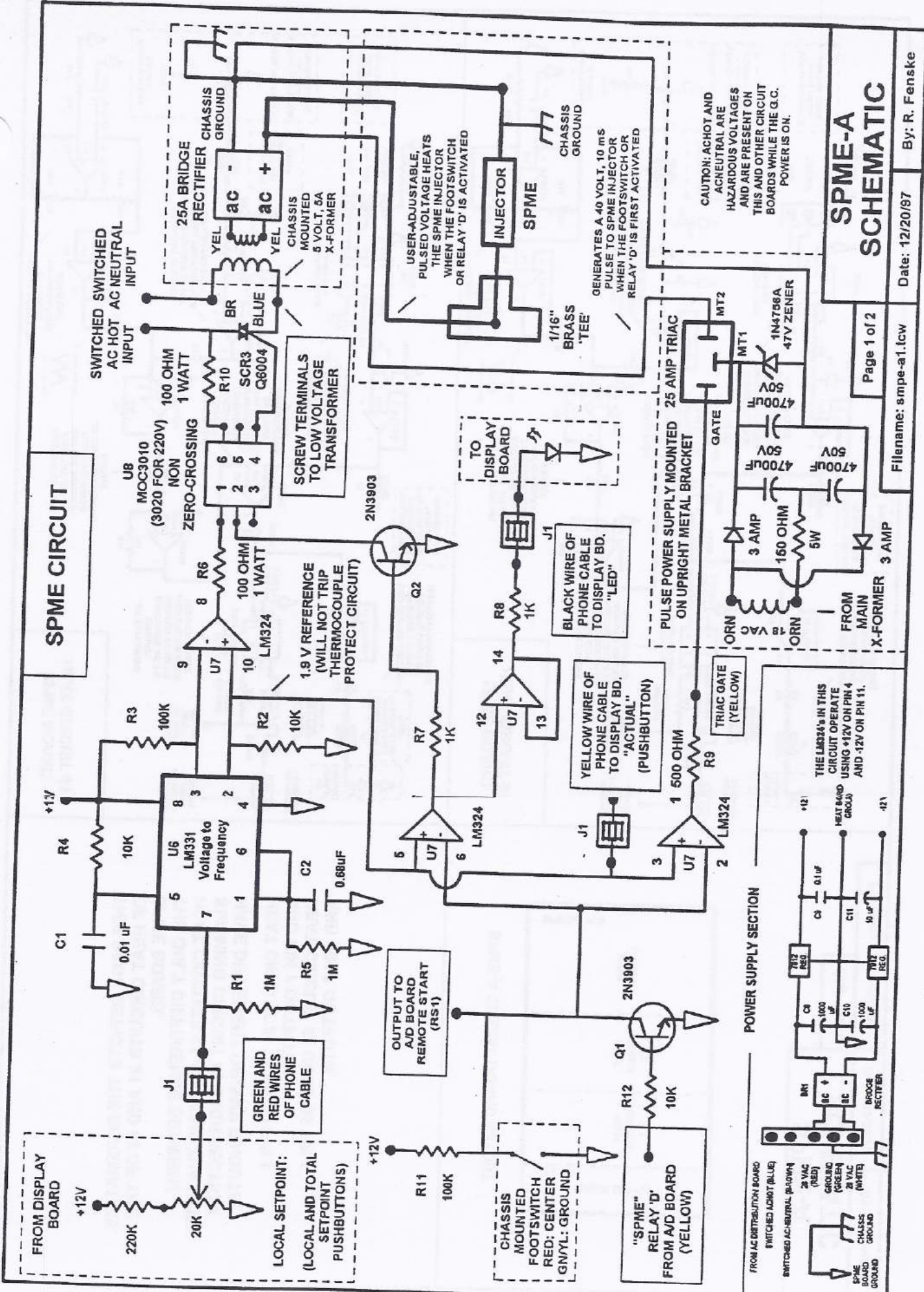
Filename: relay-c_pg1.kw

DUAL REMOTE START PULSE STRETCHER



RELAY-C SCHEMATIC

SPME CIRCUIT



CAUTION: ACHOT AND ACNEUTRAL ARE HAZARDOUS VOLTAGES AND ARE PRESENT ON THIS AND OTHER CIRCUIT BOARDS WHILE THE G.C. POWER IS ON.

USER-ADJUSTABLE PULSED VOLTAGE HEATS THE SPME INJECTOR WHEN THE FOOTSWITCH OR RELAY 'D' IS ACTIVATED

GENERATES A 40 VOLT, 10 ms PULSE TO SPME INJECTOR WHEN THE FOOTSWITCH OR RELAY 'D' IS FIRST ACTIVATED

SCREW TERMINALS TO LOW VOLTAGE TRANSFORMER

BLACK WIRE OF PHONE CABLE TO DISPLAY BD. "LED"

YELLOW WIRE OF PHONE CABLE TO DISPLAY BD. "ACTUAL" (PUSHBUTTON)

PULSE POWER SUPPLY MOUNTED ON UPRIGHT METAL BRACKET

FROM DISPLAY BOARD

LOCAL SETPOINT: (LOCAL AND TOTAL SETPOINT PUSHBUTTONS)

CHASSIS MOUNTED FOOTSWITCH RED: CENTER GN/YL: GROUND

"SPME" RELAY 'D' FROM A/D BOARD (YELLOW)

FROM AC DISTRIBUTION BOARD SWITCHED AC-NOT BLUE SPME BOARD GROUND

THE LM324's IN THIS CIRCUIT OPERATE USING +12V ON PIN 4 AND -12V ON PIN 11.

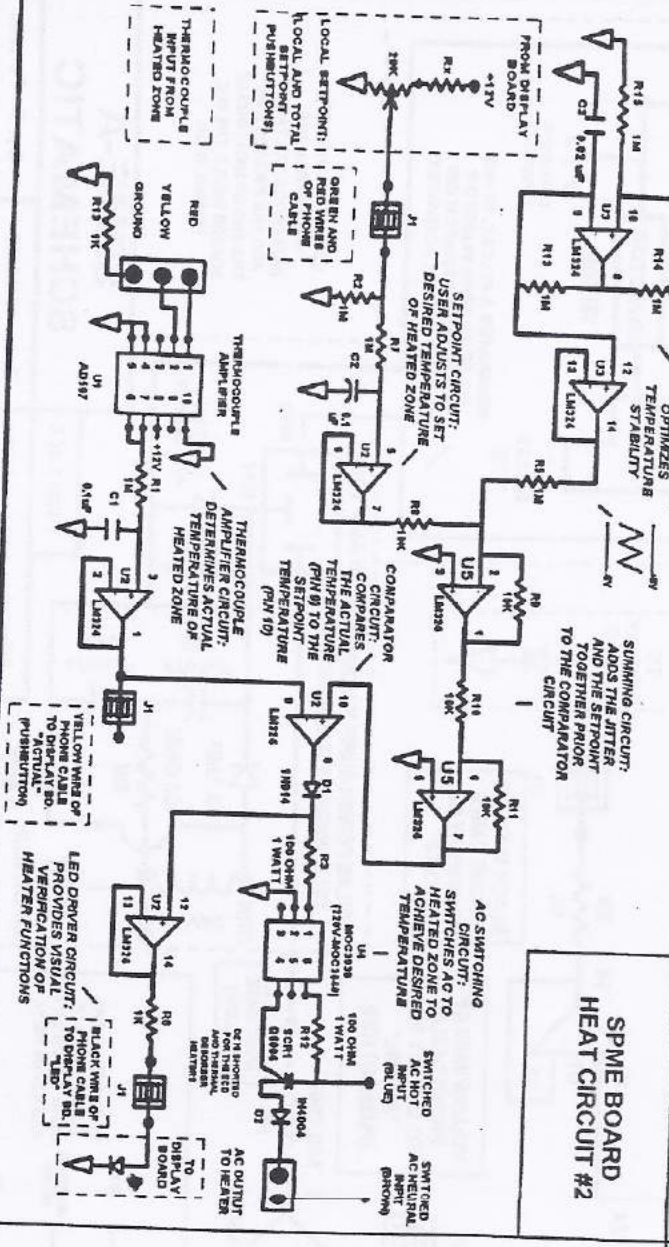
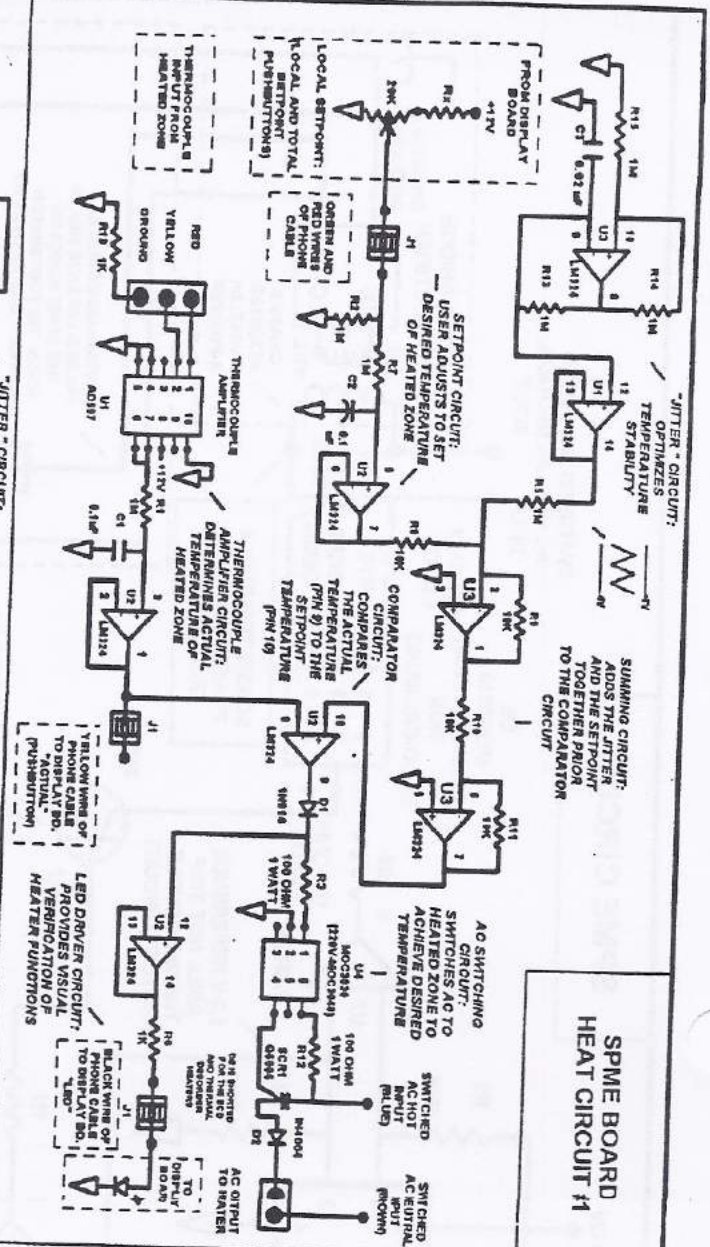
SPME-A SCHEMATIC

By: R. Fenske

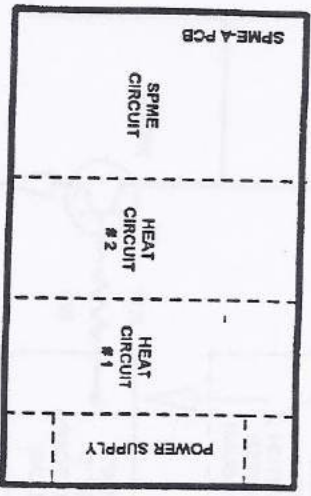
Date: 12/20/87

Page 1 of 2

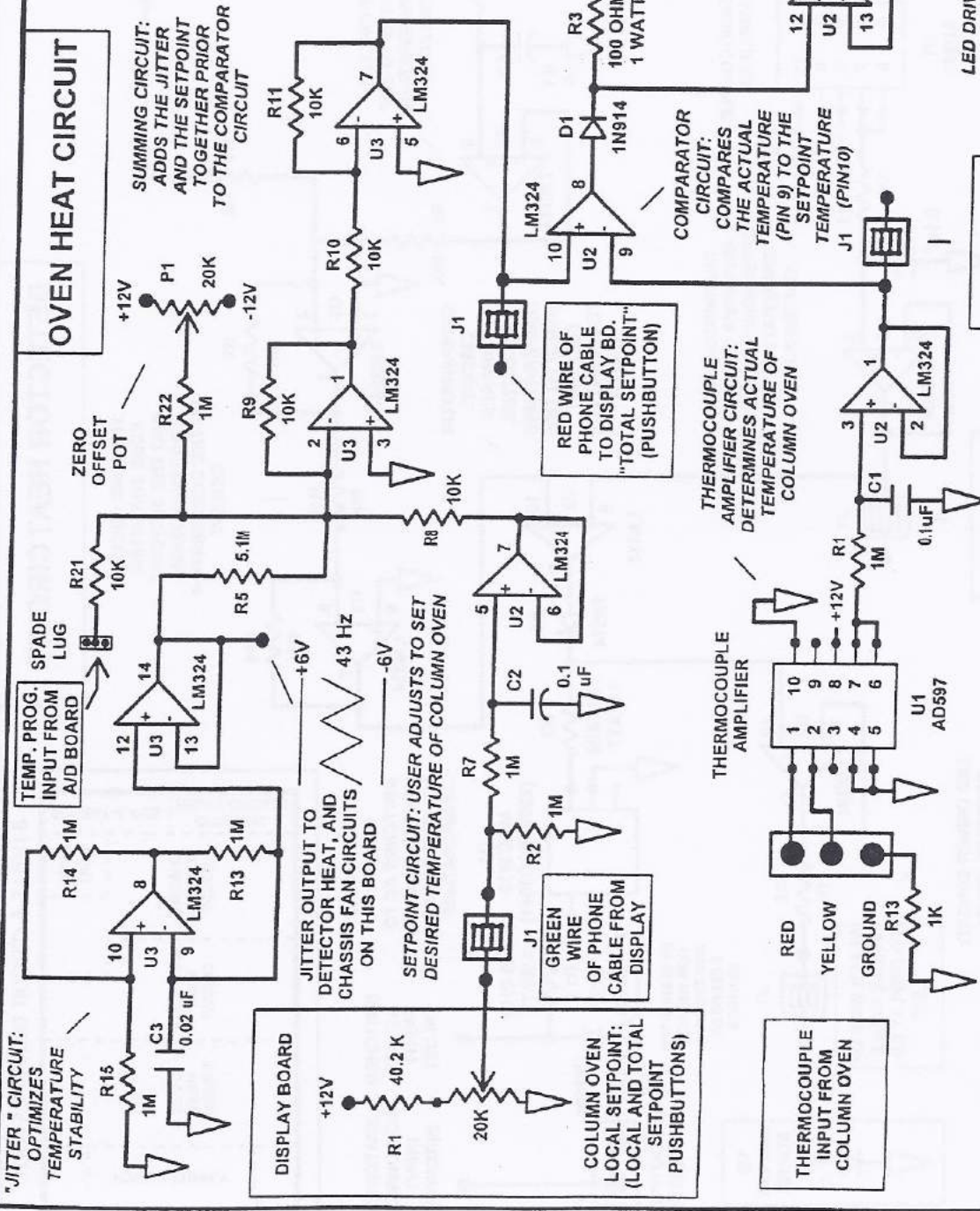
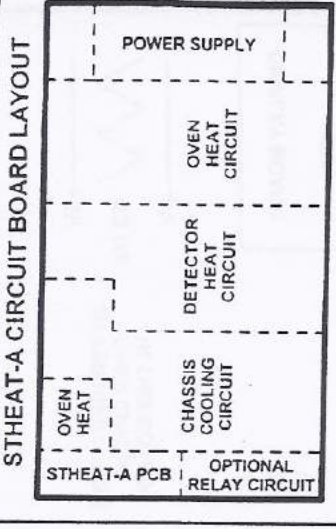
Filename: smpe-a1.tcw



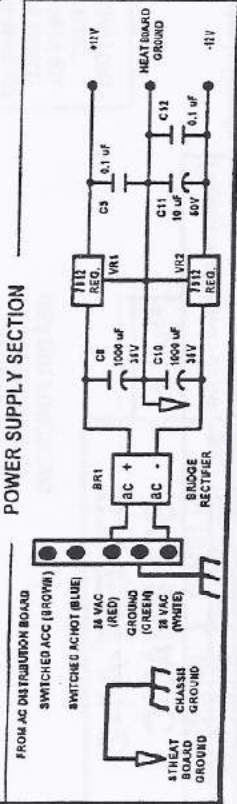
THIS PAGE DEPICTS THE SCHEMATICS OF HEAT CIRCUITS #1 AND #2 OF THE SPME BOARD. THE ONLY DIFFERENCE BETWEEN HEAT CIRCUITS #1 AND #2 IS THAT THE SUMMING CIRCUIT IN EACH SECTION HAVE DIFFERENT OP-AMP PINOUTS: HEAT CIRCUIT #1 USES U3 PIN 1 AND PIN 7 OUTPUTS. HEAT CIRCUIT #2 USES U6 PIN 1 AND PIN 7 OUTPUTS.



OVEN HEAT CIRCUIT



CAUTION: ACHOT AND ACC ARE HAZARDOUS VOLTAGES AND ARE PRESENT ON THIS AND OTHER CIRCUIT BOARDS WHILE THE G.C. POWER IS ON.



STHEAT-A1-1 SCHEMATIC

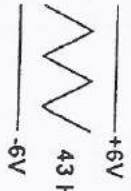
Date: 12/20/97

REV. Date: 05/15/01

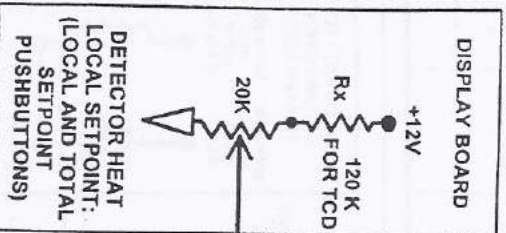
By: R. Fanske

Filename: stheat-a1-1.tcv

Page 1 of 3

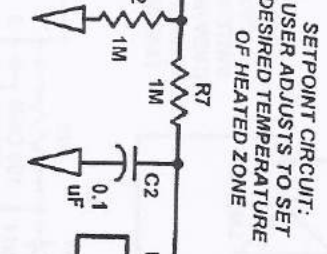


JITTER INPUT FROM OVEN CIRCUIT ON THIS BOARD

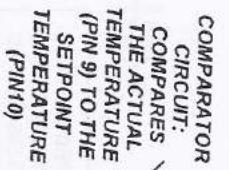


DISPLAY BOARD
+12V
Rx 120 K FOR TCD
20K

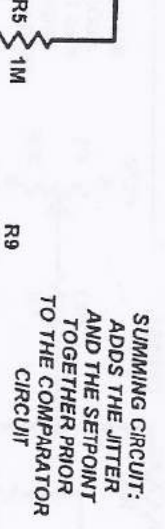
DETECTOR HEAT: LOCAL SETPOINT: (LOCAL AND TOTAL SETPOINT PUSHBUTTONS)



SETPOINT CIRCUIT: USER ADJUSTS TO SET DESIRED TEMPERATURE OF HEATED ZONE

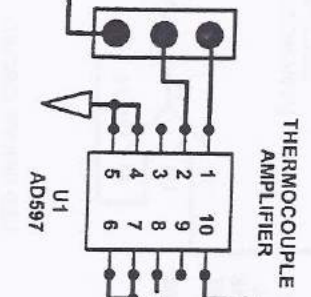
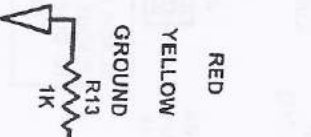


COMPARATOR CIRCUIT: COMPARES THE ACTUAL TEMPERATURE (PIN 9) TO THE SETPOINT TEMPERATURE (PIN10)



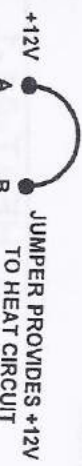
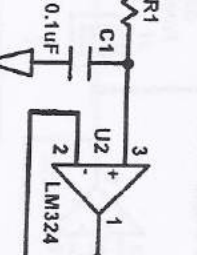
SUMMING CIRCUIT: ADDS THE JITTER AND THE SETPOINT TOGETHER PRIOR TO THE COMPARATOR CIRCUIT

DETECTOR HEAT CIRCUIT



THERMOCOUPLE AMPLIFIER

THERMOCOUPLE AMPLIFIER CIRCUIT: DETERMINES ACTUAL TEMPERATURE OF HEATED ZONE

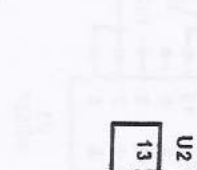
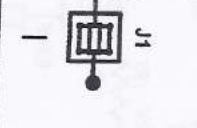


JUMPER PROVIDES +12V TO HEAT CIRCUIT

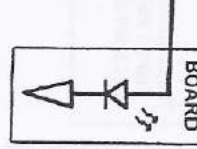
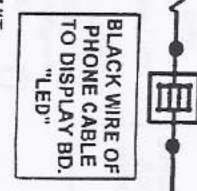
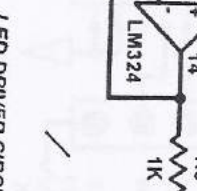
THE LM324's IN THIS CIRCUIT OPERATE USING +12V ON PIN 4 AND -12V ON PIN 11.

CAUTION: AC HOT AND AC COMMON ARE HAZARDOUS VOLTAGES AND ARE PRESENT ON THIS AND OTHER CIRCUIT BOARDS WHILE THE G.C. POWER IS ON.

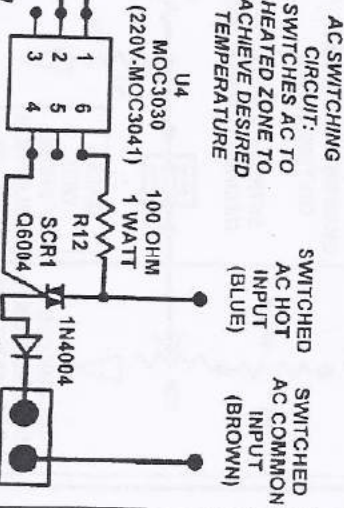
YELLOW WIRE OF PHONE CABLE TO DISPLAY BD. ("ACTUAL" PUSHBUTTON)



LED DRIVER CIRCUIT: PROVIDES VISUAL VERIFICATION OF HEATER FUNCTIONS

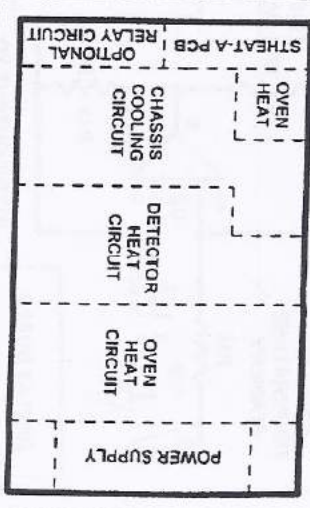


D2 IS SHORTED FOR THE ECO AND THERMAL DESORBER HEATERS



AC SWITCHING CIRCUIT: SWITCHES AC TO HEATED ZONE TO ACHIEVE DESIRED TEMPERATURE

SWITCHED AC HOT INPUT (BLUE)
SWITCHED AC COMMON INPUT (BROWN)



STHEAT-A-CIRCUIT BOARD LAYOUT

STHEAT-A1-2 SCHEMATIC

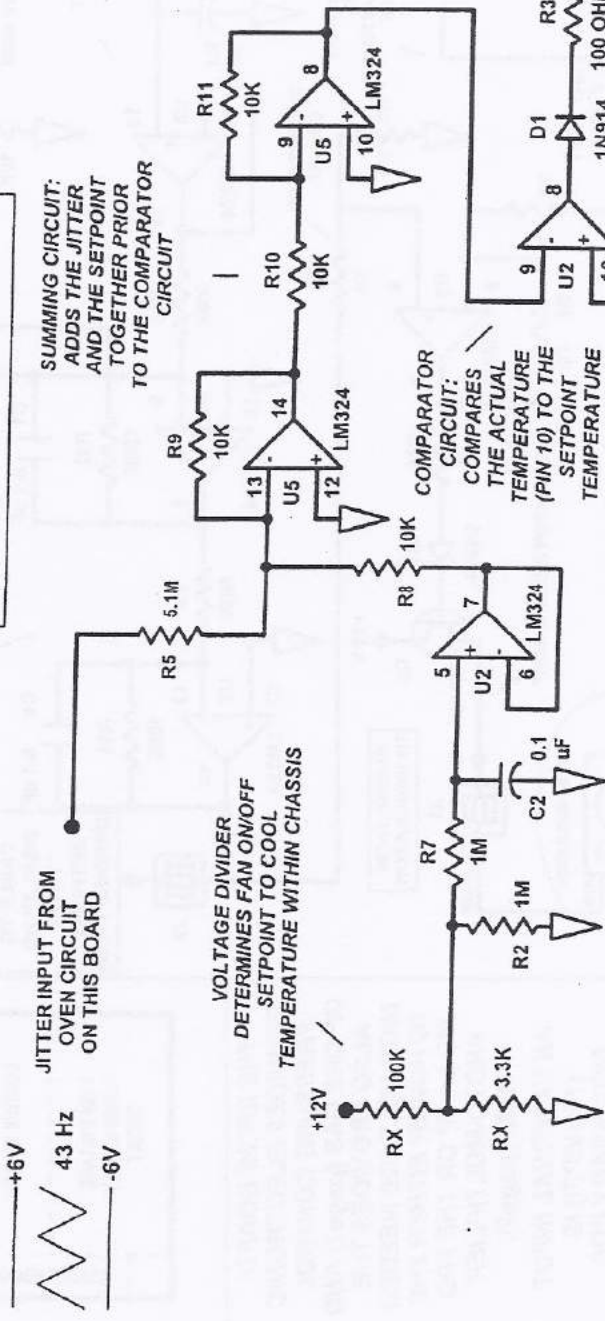
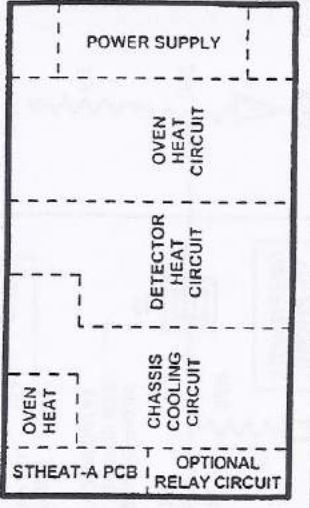
Page 2 of 3

Filename: stheat-a1-2.tcw

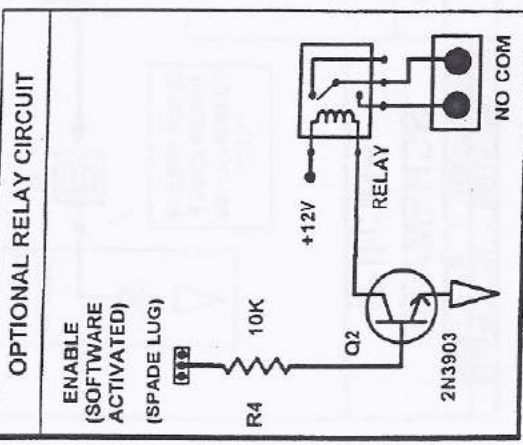
Date: 12/20/97
REV. Date: 05/15/01
By: R. Farnske
By: R. Pfeiffer

CHASSIS FAN CIRCUIT

STHEAT-A CIRCUIT BOARD LAYOUT



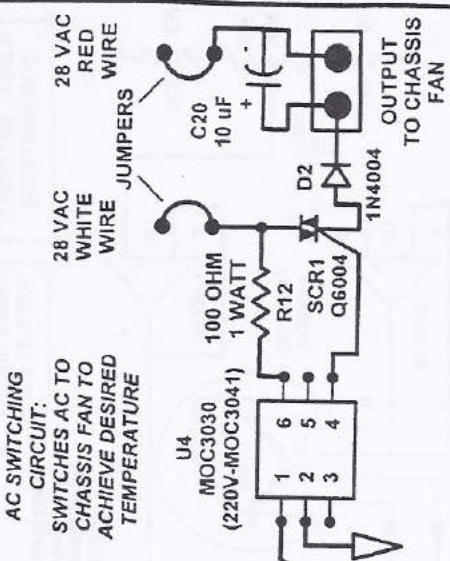
SUMMING CIRCUIT: ADDS THE JITTER AND THE SETPOINT TOGETHER PRIOR TO THE COMPARATOR CIRCUIT



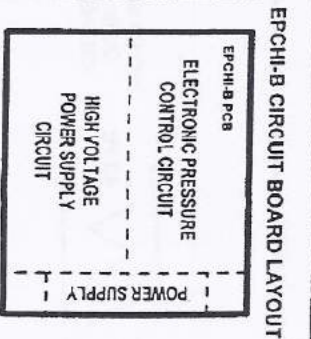
THERMOCOUPLE AMPLIFIER CIRCUIT: DETERMINES ACTUAL TEMPERATURE OF CHASSIS

CAUTION: ACHOT AND AC COMMON ARE HAZARDOUS VOLTAGES AND ARE PRESENT ON THIS AND OTHER CIRCUIT BOARDS WHILE THE G.C. POWER IS ON.

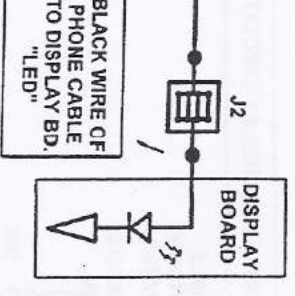
THE LM324'S IN THIS CIRCUIT OPERATE USING +12V ON PIN 4 AND -12V ON PIN 11.



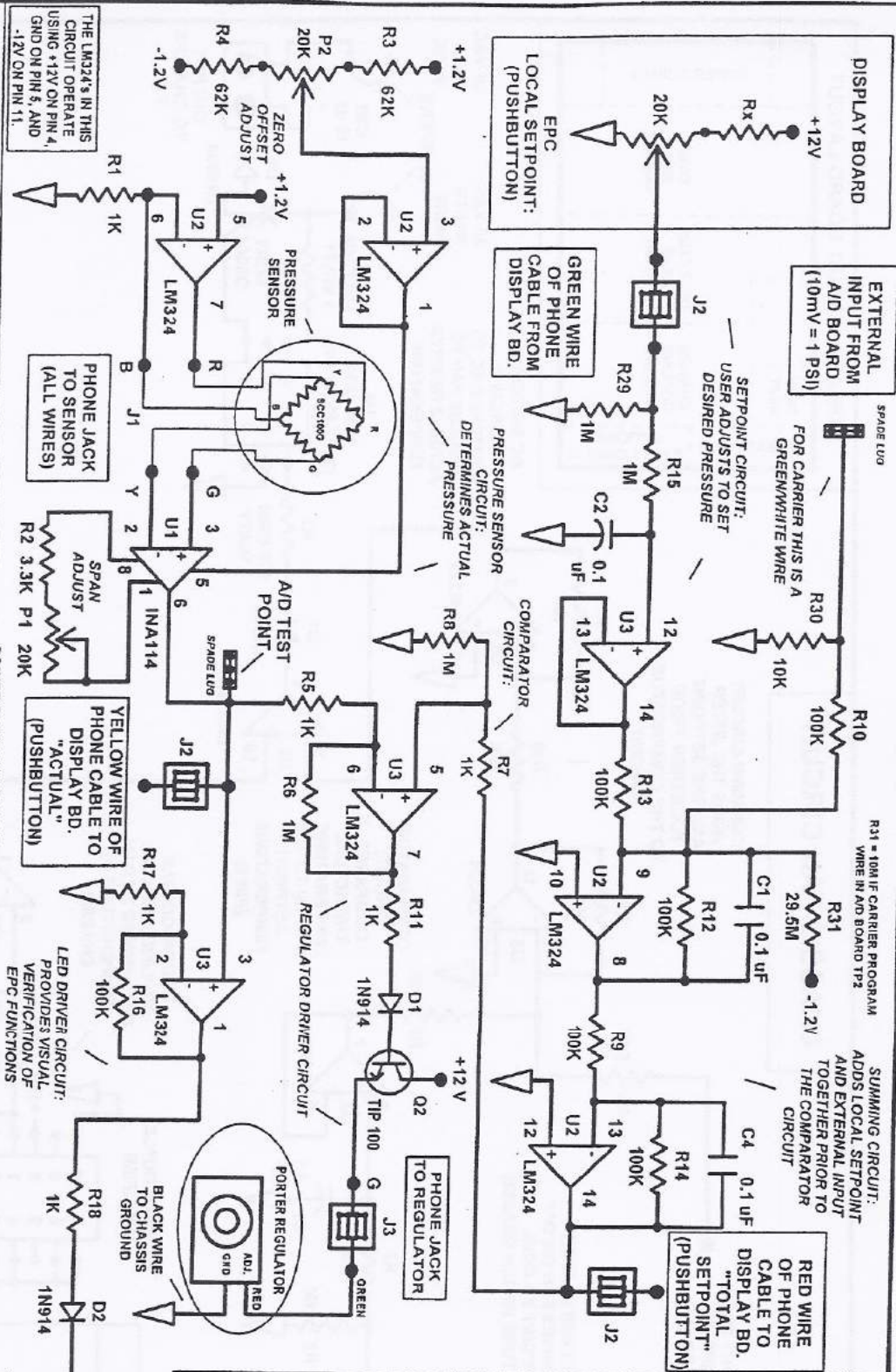
STHEAT-A1-3 SCHEMATIC



THE EPCH-B BOARD PROVIDES ELECTRONIC PRESSURE CONTROL OF ONE GAS (page 1) AND ALSO PROVIDES THE HIGH VOLTAGE NEEDED TO POWER EITHER THE PID LAMP OR THE FPD PHOTO-MULTIPLIER TUBE (page 2). AN EXTERNAL INPUT (10mV/PSI) IS NECESSARY FOR COMPUTER CONTROL OF THE EPC.

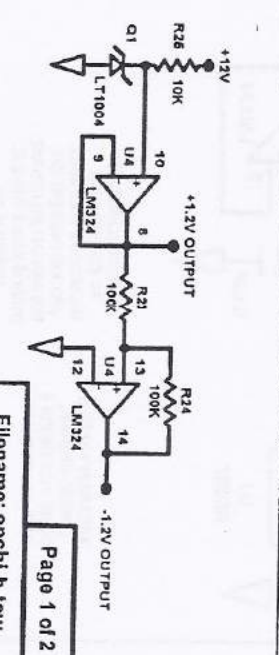
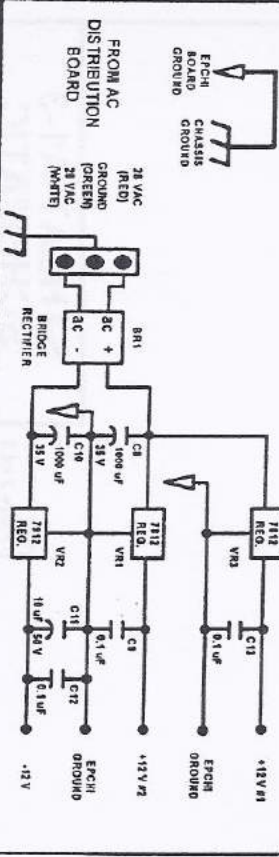


EPCH-B CIRCUIT BOARD LAYOUT



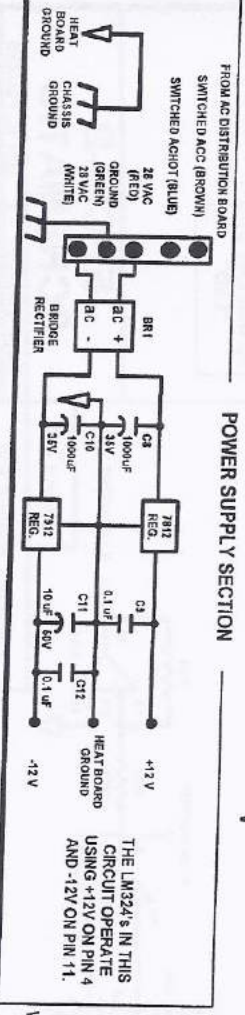
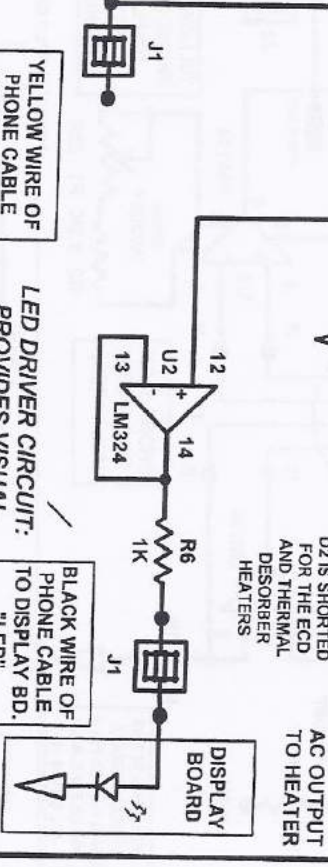
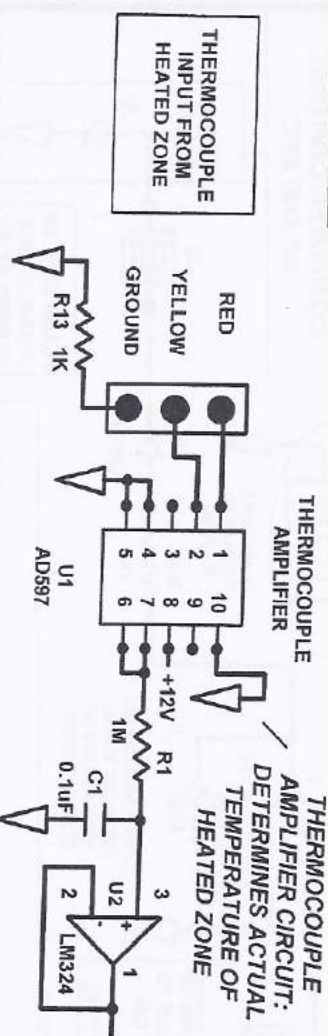
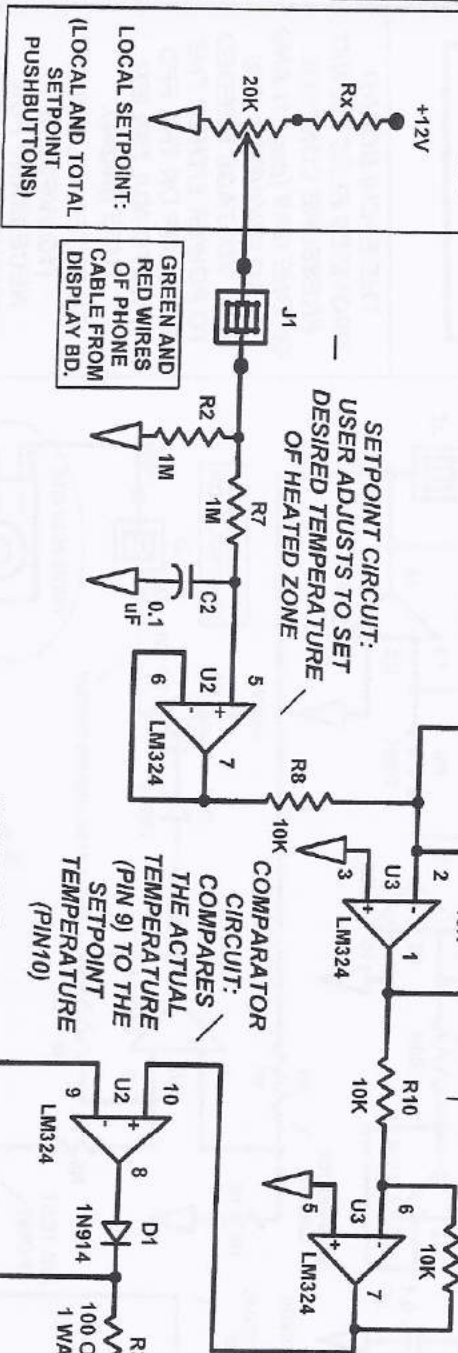
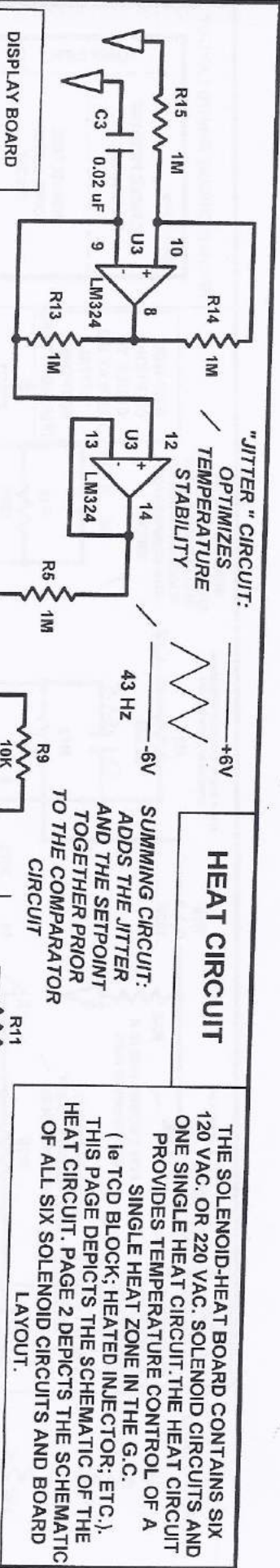
THE LM324'S IN THIS CIRCUIT OPERATE USING +12V ON PIN 4, GND ON PIN 5, AND -12V ON PIN 11.

POWER SUPPLY SECTIONS



EPCH-B SCHEMATIC

Date: 12/20/97
 Rev. Date: 4/17/02
 By: R. Fenske
 By: M. Watts



CAUTION: ACHOT AND ACC ARE HAZARDOUS VOLTAGES AND ARE PRESENT ON THIS AND OTHER CIRCUIT BOARDS WHILE THE G.C. POWER IS ON.

THE LM324's IN THIS CIRCUIT OPERATE USING +12V ON PIN 4 AND -12V ON PIN 11.

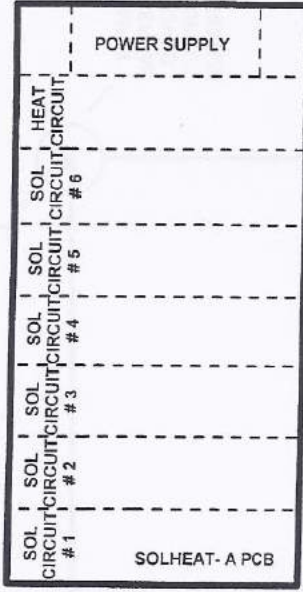
File name: solheat-a_pg1.tcw

Page 1 of 2

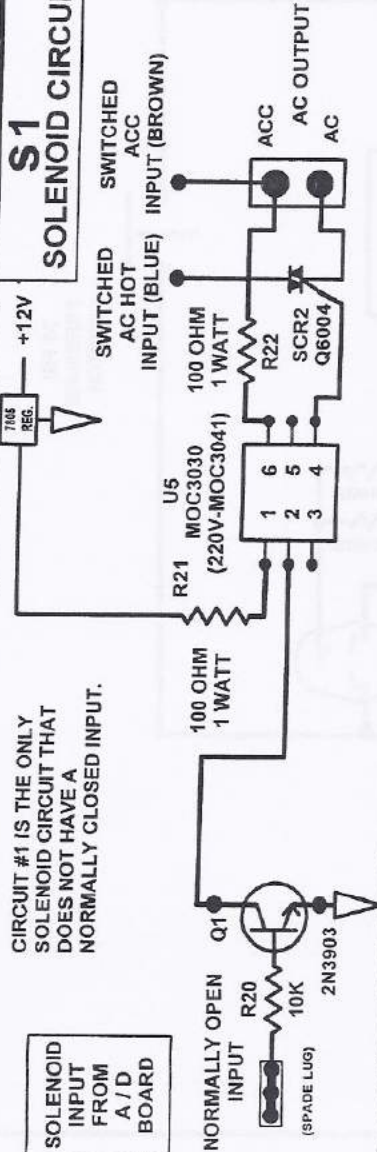
Date: 2/14/00 By: R. PFEIFFER
Rev. Date: 3/15/01 By: R. PFEIFFER

SOLHEAT-A SCHEMATIC

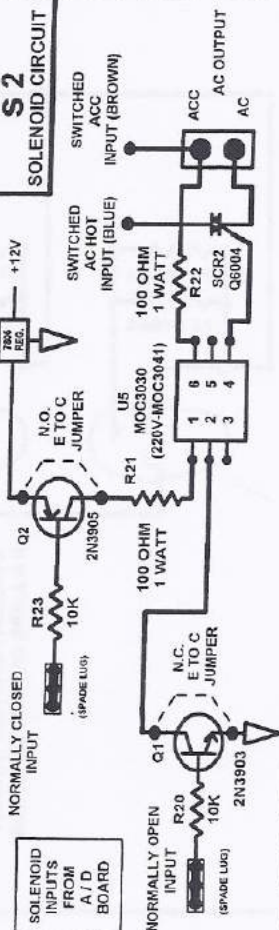
SOLHEAT - A CIRCUIT BOARD LAYOUT



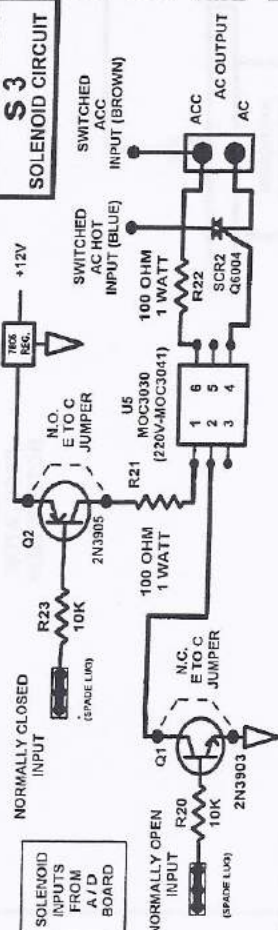
S1 SOLENOID CIRCUIT



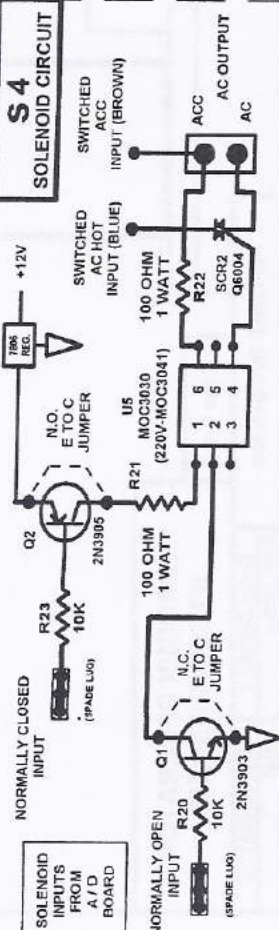
S2 SOLENOID CIRCUIT



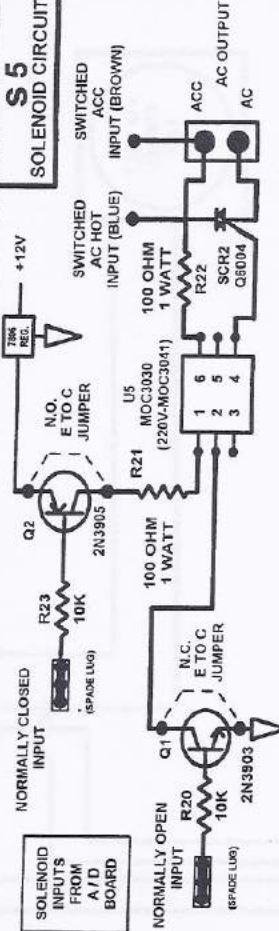
S3 SOLENOID CIRCUIT



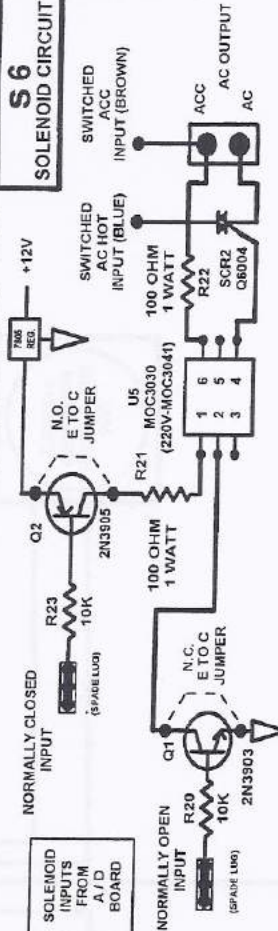
S4 SOLENOID CIRCUIT



S5 SOLENOID CIRCUIT



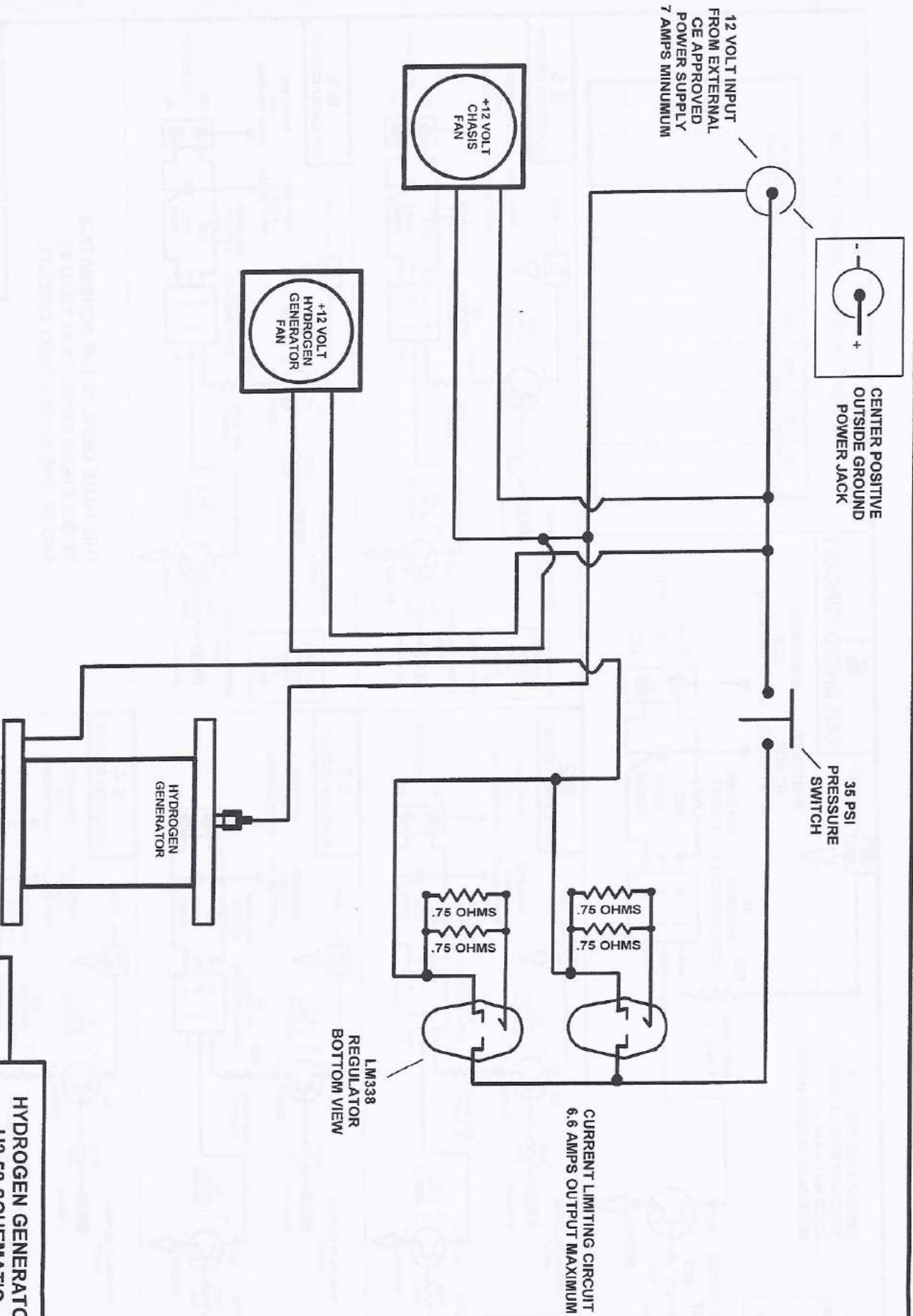
S6 SOLENOID CIRCUIT



THIS PAGE DEPICTS THE SCHEMATICS OF SOLENOID CIRCUITS #1 THRU #6 AND OF THE SINGLE HEAT CIRCUIT.

SOLHEAT - A SCHEMATIC

HYDROGEN GENERATOR STANDALONE - H2-50



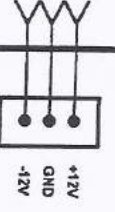
**HYDROGEN GENERATOR
H2-50 SCHEMATIC**

Page 1 of 1

Filename: hyd-gen.tcw

Date: 08/09/02 By: M. WATTS
Rev. Date: By:

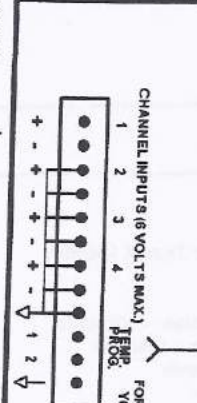
*12V AND -12V ARE SUPPLIED BY THE AMPLIFIER BOARD GROUND RUNS TO THE CHASSIS SINGLE POINT GROUND.



FOUR CHANNEL LAWSON 202 BOARD

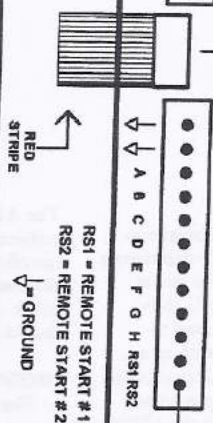
NOTE:
POWER THIS UNIT ON BEFORE BOOTING PEAKSIMPLE SOFTWARE

TEMP PROGRAM 1 OUTPUT IS CONNECTED TO THE OVEN BOARD TO CONTROL OVEN TEMPERATURE. TEMP PROGRAM 2 MAY BE USED TO CONTROL THE CARRIER E.P.C. BOTH FUNCTIONS ARE CONTROLLED BY PEAKSIMPLE SOFTWARE.



TO SERIAL DATA PORT FOR CONNECTION TO YOUR COMPUTER

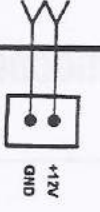
EXTERNAL EVENT Wires are connected to the TTL outputs shown below. They are 5 volts by default, and 5 volts when activated. Connect events to relays through "H" on the optional relay board if relay contact closures are needed. Use PEAKSIMPLE SOFTWARE TO ACTIVATE.



RS1 = REMOTE START #1
RS2 = REMOTE START #2
GROUND

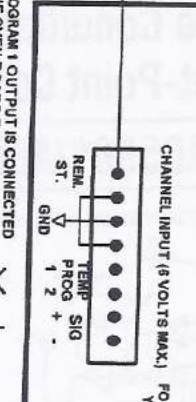
MOMENTARILY GROUNDING RS1 OR RS2 WITH A 2 SECOND PULSER ACTIVATES EITHER REMOTE START 1 OR REMOTE START 2.

*12V IS SUPPLIED BY THE AMPLIFIER BOARD GROUND RUNS TO THE CHASSIS SINGLE POINT GROUND.



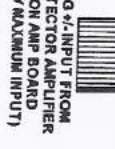
SINGLE CHANNEL LAWSON 203 BOARD

NOTE:
POWER THIS UNIT ON BEFORE BOOTING PEAKSIMPLE SOFTWARE



TO SERIAL DATA PORT FOR CONNECTION TO YOUR COMPUTER

EXTERNAL EVENT Wires are connected to the TTL outputs shown below. They are 5 volts by default, and 5 volts when activated. Connect events to relays through "H" on the optional relay board if relay contact closures are needed. Use PEAKSIMPLE SOFTWARE TO ACTIVATE.



RS1 = REMOTE START #1
RS2 = REMOTE START #2
GROUND

MOMENTARILY GROUNDING RS1 OR RS2 WITH A 2 SECOND PULSER ACTIVATES EITHER REMOTE START 1 OR REMOTE START 2.

TEMP PROGRAM 1 OUTPUT IS CONNECTED TO THE OVEN BOARD TO CONTROL OVEN TEMPERATURE. TEMP PROGRAM 2 MAY BE USED TO CONTROL THE CARRIER E.P.C. BOTH FUNCTIONS ARE CONTROLLED BY PEAKSIMPLE SOFTWARE.

THIS DRAWING DEPICTS THE INTERNAL CONNECTIONS MADE TO THE MODEL 202 AND 203 A/D BOARDS INSIDE YOUR GAS CHROMATOGRAPH. MOST MODEL 8610 AND MODEL 310 GAS CHROMATOGRAPHS HAVE ONE OF THESE BOARDS INSTALLED ON THE RIGHT SIDE OF THE G.C. CHASSIS.

Filename: 202-203layout.tcw

Page 1 of 1

202/203 A/D BOARD LAYOUTS

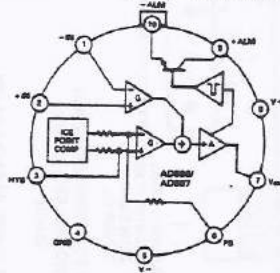
Date: 12/20/97

By: R. Fanske

FEATURES

- Low Cost
- Operates with Type J (AD596) or Type K (AD597) Thermocouples
- Built-in Cold Junction Compensation
- Temperature Proportional Operation - 10mV/°C
- Temperature Set-Point Operation - ON/OFF
- Programmable Switching Hysteresis
- High Impedance Differential Input

AD596/AD597 FUNCTIONAL BLOCK DIAGRAM



8

PRODUCT DESCRIPTION

The AD596/AD597 is a monolithic temperature set-point controller which has been optimized for use at elevated temperatures such as those found in oven control applications. The device cold junction compensates and amplifies a type J or K thermocouple input to derive an internal signal proportional to temperature. The internal signal is then compared with an externally applied set-point voltage to yield a low impedance switched output voltage. Dead-Band or switching hysteresis can be programmed using a single external resistor. Alternately, the AD596/AD597 can be configured to provide a voltage output (10mV/°C) directly from a type J or K thermocouple signal. It can also be used as a stand-alone voltage output temperature sensor.

The AD596/AD597 can be powered with a single supply from +5V to +30V, or dual supplies up to a total span of 36V. Typical quiescent supply current is 160µA which minimizes self-heating errors.

The AD596/AD597 includes a thermocouple failure alarm that indicates an open thermocouple lead when operated in the temperature proportional measurement mode. The alarm output has a flexible format which can be used to drive relays, LEDs or TTL logic.

The device is packaged in a reliability qualified, cost effective 10-pin metal can and is trimmed to operate over an ambient temperature range from +25°C to +100°C. Operation over an extended ambient temperature range is possible with slightly reduced accuracy. The AD596 will amplify thermocouple signals covering the entire -200°C to +760°C temperature range recommended for type J thermocouples while the AD597 can accommodate -200°C to +1250°C type K inputs.

The AD596/AD597 has a calibration accuracy of ±4°C at an ambient temperature of 60°C and an ambient temperature stability specification of 0.05°C/°C from +25°C to +100°C. If higher accuracy, or a lower ambient operating temperature is required, either the AD594 (J thermocouple) or AD595 (K thermocouple) should be considered.

PRODUCT HIGHLIGHTS

1. The AD596/AD597 provides cold junction compensation and a high gain amplifier which can be used as a set-point comparator.
2. The input stage of the AD596/AD597 is a high quality instrumentation amplifier that allows the thermocouple to float over most of the supply voltage range.
3. Linearization not required for thermocouple temperatures close to 175°C (+100°C to +540°C for AD596).
4. Cold junction compensation is optimized for ambient temperatures ranging from +25°C to +100°C.
5. In the stand-alone mode, the AD596/AD597 produces an output voltage that indicates its own temperature.

*Protected by U.S. Patent No. 4,029,974.

FEATURES

- **Ultra-Low Bias Current:**
 - 150 femtoamps Typ at +25°C
 - 300 femtoamps Typ at +85°C
 - 500 femtoamps Typ at +125°C
- **True Single Supply Operation**
Common-Mode Range Includes Ground
Output Swings to Within 200 μ V of Ground Without
Pulldown Resistors
- **Low Supply Current** 325 μ A Max
- **Lower Cost Alternative to AD549 and OPA128**
- **Low Cost**
- **Inputs Protected Against 700V of Static Discharge**
- **Available in Die Form**

APPLICATIONS

- Electrometer Amplifier Input Stage
- Photodiode and Infrared Detector Preamplifier
- Chemical and Gas Analyzers
- pH Probe Buffer Amplifier
- Fire Detectors
- High Voltage Voltmeters
- Charge Amplifiers

GENERAL DESCRIPTION

The OP-80 is a low cost CMOS operational amplifier offering exceptionally low input currents over a wide operating tempera-

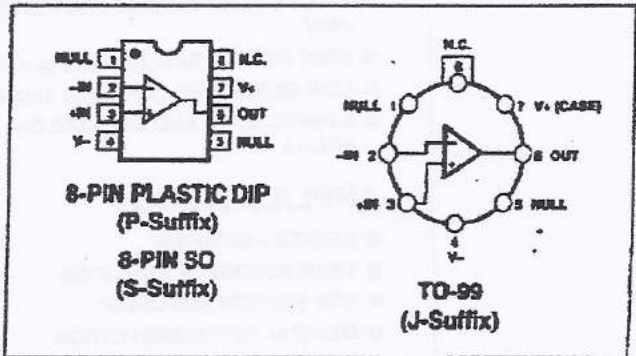
ture range. Input current is typically 150 femtoamps at 25°C and increases to only 300 femtoamps at +85°C, with exceptionally high common-mode and differential input impedances. Incorporating a novel input protection design, the OP-80 achieves over 700V of ESD protection while maintaining very low input current.

For systems demanding both high performance at low supply voltages and high input impedances, the OP-80 is a powerful design tool. It is ideal for use in electrometers, portable medical instrumentation, chemical analyzers, smoke detectors, and sensitive current-to-voltage conversion circuits for photodiodes.

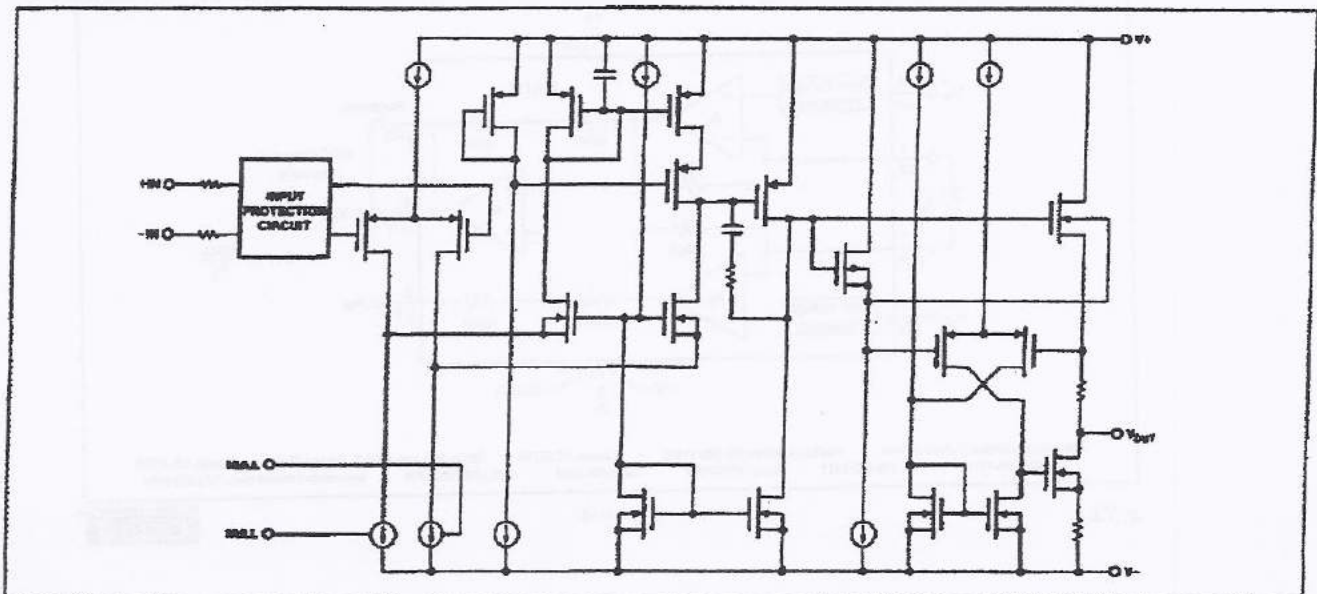
The low supply current minimizes thermal power dissipation, virtually eliminating the effects of chip self-heating. The OP-80's CMOS design gives a good speed/power ratio, permitting a

Continued

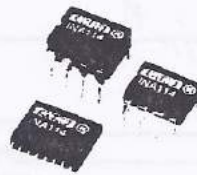
PIN CONNECTIONS



SIMPLIFIED SCHEMATIC



For Immediate Assistance, Contact Your Local Salesperson



INA114

Precision INSTRUMENTATION AMPLIFIER

FEATURES

- **LOW OFFSET VOLTAGE:** 50 μ V max
- **LOW DRIFT:** 0.25 μ V/ $^{\circ}$ C max
- **LOW INPUT BIAS CURRENT:** 2nA max
- **HIGH COMMON-MODE REJECTION:** 115dB min
- **INPUT OVER-VOLTAGE PROTECTION:** \pm 40V
- **WIDE SUPPLY RANGE:** \pm 2.25 to \pm 18V
- **LOW QUIESCENT CURRENT:** 3mA max
- **8-PIN PLASTIC AND CERAMIC DIP, SOL-16**

APPLICATIONS

- BRIDGE AMPLIFIER
- THERMOCOUPLE AMPLIFIER
- RTD SENSOR AMPLIFIER
- MEDICAL INSTRUMENTATION
- DATA ACQUISITION

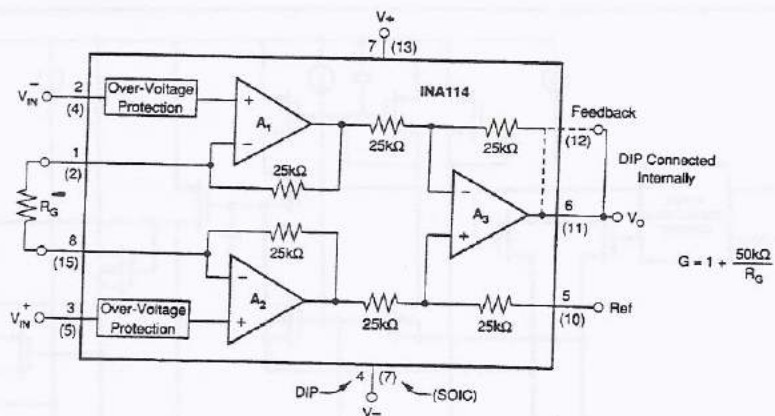
DESCRIPTION

The INA114 is a low cost, general purpose instrumentation amplifier offering excellent accuracy. Its versatile 3-op amp design and small size make it ideal for a wide range of applications.

A single external resistor sets any gain from 1 to 10,000. Internal input protection can withstand up to \pm 40V without damage.

The INA114 is laser trimmed for very low offset voltage (50 μ V), drift (0.25 μ V/ $^{\circ}$ C) and high common-mode rejection (115dB at G = 1000). It operates with power supplies as low as \pm 2.25V, allowing use in battery operated and single 5V supply systems. Quiescent current is 3mA maximum.

The INA114 is available in 8-pin plastic and ceramic DIPs, and SOL-16 surface-mount packages, specified for the -40° C to $+85^{\circ}$ C temperature range.



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For Immediate Assistance, Contact Your Local Salesperson



INA117

High Common-Mode Voltage DIFFERENCE AMPLIFIER

FEATURES

- COMMON-MODE INPUT RANGE:
 $\pm 200V$ ($V_s = \pm 15V$)
- PROTECTED INPUTS:
 $\pm 500V$ Common-Mode
 $\pm 500V$ Differential
- UNITY GAIN: 0.02% Gain Error max
- NONLINEARITY: 0.001% max
- CMRR: 86dB min

APPLICATIONS

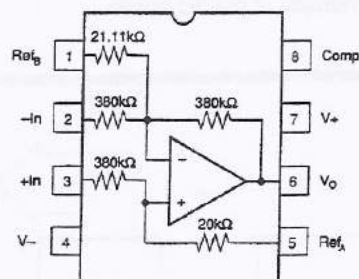
- CURRENT MONITOR
- BATTERY CELL-VOLTAGE MONITOR
- GROUND BREAKER
- INPUT PROTECTION
- SIGNAL ACQUISITION IN NOISY ENVIRONMENTS
- FACTORY AUTOMATION

DESCRIPTION

The INA117 is a precision unity-gain difference amplifier with very high common-mode input voltage range. It is a single monolithic IC consisting of a precision op amp and integrated thin-film resistor network. It can accurately measure small differential voltages in the presence of common-mode signals up to $\pm 200V$. The INA117 inputs are protected from momentary common-mode or differential overloads up to $\pm 500V$.

In many applications, where galvanic isolation is not essential, the INA117 can replace isolation amplifiers. This can eliminate costly isolated input-side power supplies and their associated ripple, noise and quiescent current. The INA117's 0.001% nonlinearity and 200kHz bandwidth are superior to those of conventional isolation amplifiers.

The INA117 is available in 8-pin plastic mini-DIP and SO-8 surface-mount packages, specified for the $0^\circ C$ to $+70^\circ C$ temperature range. The metal TO-99 models are available specified for the $-25^\circ C$ to $+85^\circ C$ and $-55^\circ C$ to $+125^\circ C$ temperature range.



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4.100

PDS-748F



FEATURES

- Very small, ideal for thru/behind the panel or PC board mounting
- Full size (0.56") digit height
- Packaged in a 12-pin plastic DIP, with a color filter case (0.9"H x 2.1"W x 0.5"D)
- Available in many bright LED colors: red, orange, amber, yellow, green, blue, and aqua
- Super bright versions available
- Low power 50mW models available
- Differential inputs with optional ranges of ± 200 mV, ± 2 V, and ± 20 V dc
- Factory calibrated to within ± 1 count, no external adjustments necessary
- Autozero A/D converter for long term stability with no adjustments
- A +5V supply is the only power required
- "Display Test" pin available
- User-selectable decimal point placement
- Fully encapsulated package well suited for harsh environments
- Many optional support products to cover virtually all possible applications
- Installation tools for easy prototyping available: cut-out punch, retaining clip inserter, evaluation board

GENERAL DESCRIPTION

The DMS-30PC Series is a line of fully operational, self-contained and complete 3 1/2 digit voltmeters. The very small size of these digital voltmeters has been achieved by integrating the display and converter circuitry into one assembly, using the most modern microelectronic hybrid packaging techniques.

The result is a very small and solid digital voltmeter which can be handled like a component unlike awkward PC boards or conventional meters housed in plastic boxes.



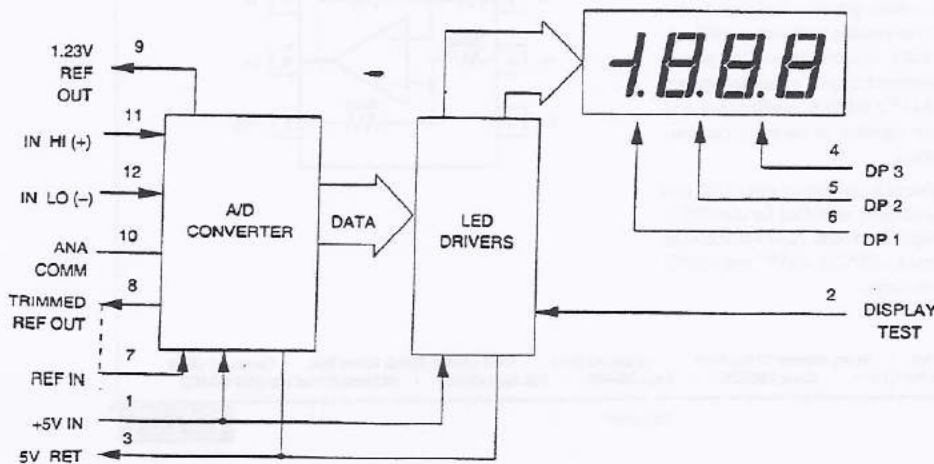
CMR to 86 dB, high impedance, differential input, overvoltage protection (to ± 250 V dc), and a built-in, high stability, double regulated reference circuit allows for extreme accuracy (0.05%, ± 1 digit), repeatability and a very long MTBF.

The large (0.56") 3 1/2 digit LED display is available in a wide variety of colors including: red, orange, amber, yellow, green, and blue to suit every application. The DMS-30PC Series meters are available in three voltage input ranges: ± 200 mV (DMS-30PC-0), ± 2 V dc (DMS-30PC-1), and ± 20 V dc (DMS-30PC-2).

Input impedances are 1,000 megohms for both the ± 200 mV and ± 2 V dc models and 1 megohm for the ± 20 V dc model, minimizing circuit loading. A single +5V dc supply (no other parts required) makes the DMS-30PC Series fully operational over a very broad temperature range of 0 to +60 °C.

The DMS-30PC Series is ideal for high performance, high reliability measurement systems where low cost and ease of use are paramount.

The built-in bezel, low power drain, fully encapsulated (plastic) case, and small footprint with large LED display were designed for direct pc board mounting, panel mount application, and mobile/portable instrumentation.



APPLICATIONS

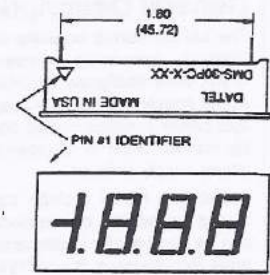
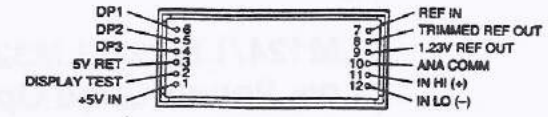
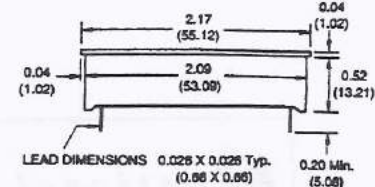
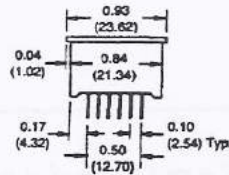
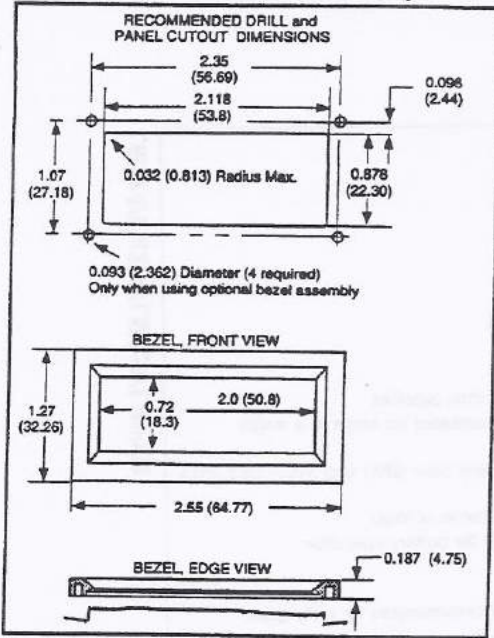
- Board-level diagnostics
- Weigh scales
- Automatic test equipment
- Avionics displays
- Lab/test equipment
- Digital thermometers
- Harsh environment useage
- Process monitoring
- Portable/mobile instruments

Figure 1. DMS-30PC Simplified Block Diagram

MECHANICAL DIMENSIONS

INCHES
(mm)

Panel Cutout Dimensions and
Optional Bezel Assembly

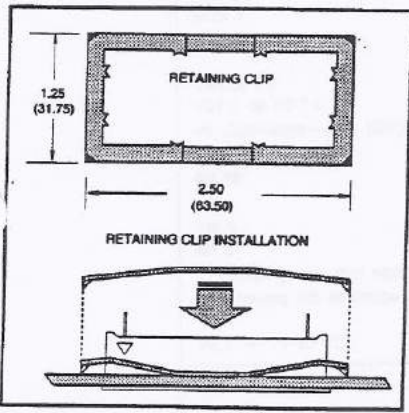


Recommended printed circuit board finished hole diameter is 0.042 (1.067), ±0.002 (0.051)

Tolerances Unless
Otherwise Specified

2 Decimal Places ±0.02 (±0.50)
3 Decimal Places ±0.010 (±0.254)

Mounting Clip



ORDERING INFORMATION

DMS-30PC-X-XX

INPUT RANGE

- 0 = +200mV
- 1 = ±2V
- 2 = ±20V

LED COLOR

- YS = Yellow
- OS = Orange
- AS = Amber
- BS = Blue
- RS = Red
- GS = Green
- QS = Aqua
- RH = High Intensity Red
- RL = Low Power Red
- GL = Low Power Green
- OL = Low Power Orange

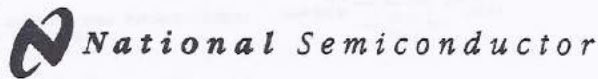
ACCESSORIES

- RN-DMS Gain/Offset potentiometer kit for DMS-EB, DMS-EB-AC/DC, and DMS-EB-DC/DC (see below)
- DMS-30-CP Panel cutout punch
- DMS-BZL1 DMS-30 Bezel Assembly
- DMS-BZL2 DMS-30 Bezel Assembly with NEMA 4 gasket

ADD-ON APPLICATION BOARDS

- DMS-EB Multipurpose (4-20mA, gain/offset adjust)
- DMS-EB-HTB High accuracy temperature probe sensing for 200mV models
- DMS-EB-DC/DC Provides isolated +5V power
- DMS-EB-TCJ J-type thermocouple inputs for ±2V models
- DMS-EB-TCK K-type thermocouple inputs for ±2V models
- DMS-EB-RMS For true RMS measurements of AC voltages
- DMS-EB-AC/DC For AC line-powered applications
- DMS-EB-LP For 4-20mA loop-powered applications

DATEL makes no representation that the use of these products in the circuits described herein, or use of other technical information contained herein, will not infringe upon existing or future patent rights nor do the descriptions contained herein imply the granting of licenses to make, use, or sell equipment constructed in accordance therewith. Specifications subject to change without notice.



LM124/LM224/LM324/LM2902 Low Power Quad Operational Amplifiers

General Description

The LM124 series consists of four independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, DC gain blocks and all the conventional op amp circuits which now can be more easily implemented in single power supply systems. For example, the LM124 series can be directly operated off of the standard +5V power supply voltage which is used in digital systems and will easily provide the required interface electronics without requiring the additional $\pm 15V$ power supplies.

Unique Characteristics

- In the linear mode the input common-mode voltage range includes ground and the output voltage can also swing to ground, even though operated from only a single power supply voltage
- The unity gain cross frequency is temperature compensated
- The input bias current is also temperature compensated

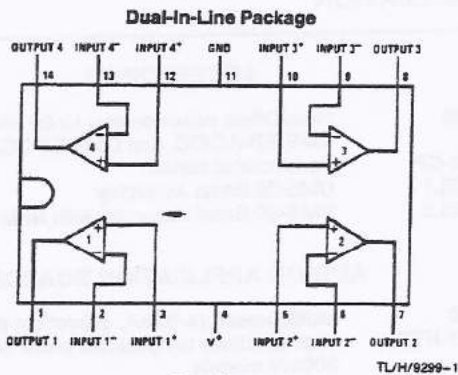
Advantages

- Eliminates need for dual supplies
- Four internally compensated op amps in a single package
- Allows directly sensing near GND and V_{OUT} also goes to GND
- Compatible with all forms of logic
- Power drain suitable for battery operation

Features

- Internally frequency compensated for unity gain
- Large DC voltage gain 100 dB
- Wide bandwidth (unity gain) 1 MHz
(temperature compensated)
- Wide power supply range:
 - Single supply 3V to 32V
 - or dual supplies $\pm 1.5V$ to $\pm 16V$
- Very low supply current drain (700 μA)—essentially independent of supply voltage
- Low input biasing current 45 nA
(temperature compensated)
- Low input offset voltage 2 mV
and offset current 5 nA
- Input common-mode voltage range includes ground
- Differential input voltage range equal to the power supply voltage
- Large output voltage swing 0V to V^+ - 1.5V

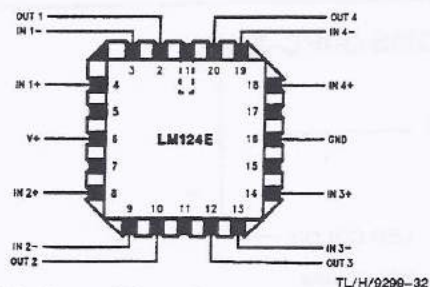
Connection Diagram



Top View

Order Number LM124J, LM124AJ, LM124J/883**,
LM124AJ/883*, LM224J, LM224AJ, LM324J, LM324M,
LM324AM, LM2902M, LM324N, LM324AN or LM2902N
See NS Package Number J14A, M14A or N14A

*LM124A available per JM38510/11005
**LM124 available per JM38510/11005



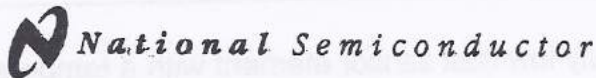
Order Number LM124AE/883 or LM124E/883
See NS Package Number E20A



Order Number LM124AW/883 or LM124W/883
See NS Package Number W14B

LM124/LM224/LM324/LM2902

1



LF155/LF156/LF157 Series Monolithic JFET Input Operational Amplifiers

General Description

These are the first monolithic JFET input operational amplifiers to incorporate well matched, high voltage JFETs on the same chip with standard bipolar transistors (BI-FET™ Technology). These amplifiers feature low input bias and offset currents/low offset voltage and offset voltage drift, coupled with offset adjust which does not degrade drift or common-mode rejection. The devices are also designed for high slew rate, wide bandwidth, extremely fast settling time, low voltage and current noise and a low 1/f noise corner.

Advantages

- Replace expensive hybrid and module FET op amps
- Rugged JFETs allow blow-out free handling compared with MOSFET input devices
- Excellent for low noise applications using either high or low source impedance—very low 1/f corner
- Offset adjust does not degrade drift or common-mode rejection as in most monolithic amplifiers
- New output stage allows use of large capacitive loads (5,000 pF) without stability problems
- Internal compensation and large differential input voltage capability

Applications

- Precision high speed integrators
- Fast D/A and A/D converters
- High impedance buffers
- Wideband, low noise, low drift amplifiers
- Logarithmic amplifiers

- Photocell amplifiers
- Sample and Hold circuits

Common Features

(LF155A, LF156A, LF157A)

■ Low input bias current	30 pA
■ Low Input Offset Current	3 pA
■ High input impedance	10 ¹² Ω
■ Low input offset voltage	1 mV
■ Low input offset voltage temp. drift	3 μV/°C
■ Low input noise current	0.01 pA/√Hz
■ High common-mode rejection ratio	100 dB
■ Large dc voltage gain	106 dB

Uncommon Features

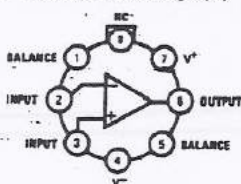
	LF155A	LF156A	LF157A (A _V = 5)	Units
■ Extremely fast settling time to 0.01%	4	1.5	1.5	μs
■ Fast slew rate	5	12	50	V/μs
■ Wide gain bandwidth	2.5	5	20	MHz
■ Low input noise voltage	20	12	12	nV/√Hz

*C = 3 pF in LF157 series.

TL/H/5848-13

Connection Diagrams (Top Views)

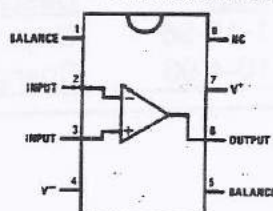
Metal Can Package (H)



TL/H/5848-14

Order Number LF156AH, LF155H, LF156H, LF255H, LF256H, LF257H, LF355AH, LF356AH, LF357AH, LF356BH, LF355H, LF356H, LF357H, LM155AH/883, LM155H/883, LM156AH/883, LM156H/883, LM157AH/883 or LM157H/883*
See NS Package Number H08C

Dual-In-Line Package (M and N)



TL/H/5848-20

Order Number LF355M, LF356M, LF357M, LF355BM, LF356BM, LF355BN, LF356BN, LF357BN, LF355N, LF356N or LF357N
See NS Package Number M08A or N08E

LF155/LF156/LF157

SCC100GS/SZ75400

Special 0 to 100 psig Pressure Sensors for SRI

Preliminary 1/15/96

General Description

The SCC series sensors offer an extremely low cost sensor element with a temperature stable output when driven with a constant current source. These integrated circuit sensors were designed for extremely cost sensitive applications where precise accuracy over a wide temperature range is not required. This part features a protective parylene coating over the sensor element. However, this device type is intended for use with non-corrosive, non-ionic working fluids such as air, dry gases, and the like.

The SZ75400 special for SRI is different than the standard SCC100GS in that it has a special long tube attached for pressure connection. All else is per the standard specifications for the SCC100GS product.

Contact your local SenSym representative or the SenSym factory for additional details.

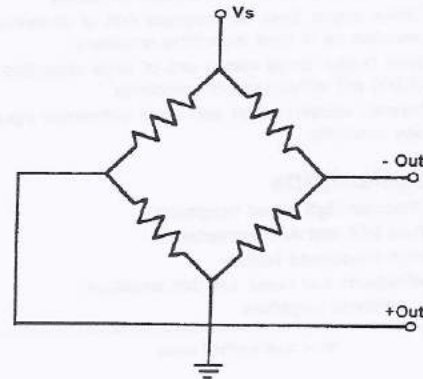
Features

- **Low Cost**
- **Internal Temperature Compensation**
- **Small Size**
- **Gage Pressure**
- **Reliable Semiconductor Technology**

Applications

- **Special Sensors for SRI**

Closed Circuit



Revision History

<u>Revision</u>	<u>Date</u>	<u>Description</u>
0	1-15-96	Original Specification
1	10-4-96	Change to Closed Bridge

Drawing Approvals

SenSym, Inc.:

Printed Name/Title

Signature

Date

SRI:

Printed Name/Title

Signature

Date

**Pressure Sensor Characteristics
Environmental Specifications**

Temperature Ranges:

Compensated	0°C to +50°C
Operating	-40°C to +85°C
Storage	-55°C to +125°C

Humidity: 0 to 100%RH

Maximum Ratings

Supply Current $I_s = 1.5\text{mA}$

Lead Temperature (Soldering 2 - 4 sec) 250°C

Pressure Range Specifications

SenSym PART NO.	SRI PART NO.	PRESSURE RANGE	PROOF PRESSURE ⁽⁷⁾
SCC100GS/SZ75400		0-100 PSIG	150 PSIG

Performance Characteristics ⁽¹⁾

Characteristic	min	typical	max	units
Zero pressure offset (@ $T_A=25^\circ\text{C}$)	-30.0	-10.0	+20.0	mV
Full scale span ⁽²⁾	85	155	225	mV
Linearity, hysteresis & repeatability ⁽³⁾	-0.5	0.1	0.5	%FSO
Temp. effect on span ⁽⁴⁾	-1.5	0.25	1.5	%FSO
Temp. effect on offset ⁽⁴⁾	—	45	90	$\mu\text{V}/^\circ\text{C}$
Long term stability of offset span ⁽⁵⁾	—	0.1	—	%FSO
Response time (10% to 90%) ⁽⁶⁾	—	0.1	—	ms
Input resistance (@ $T_A=25^\circ\text{C}$)	4.0	5.0	6.5	k
Output impedance	4.0	5.0	6.5	k

Specification Notes:

Note 1: Reference Conditions (unless otherwise noted): Supply current, $I_s=1.0\text{ mA}$; $T_A=25^\circ\text{C}$.

Note 2: Span is the algebraic difference between the output voltage at full scale pressure and the output at zero pressure. Span is ratiometric to the supply voltage.

Note 3: Linearity is based on best fit straight line. Hysteresis is the maximum output difference at any point within the operating pressure range for increasing and decreasing pressure.

Note 4: Maximum error band of the offset voltage and the error of the band of the span over the compensated temperature range, relative to the 25°C reading. Typical temperature coefficients for span and resistance are -2200 ppm/°C respectively.

Temperature effects on offset and span are guaranteed by design. These parameters are not 100% tested in production.

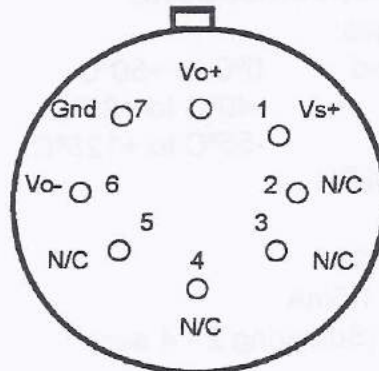
Note 5: Long term stability over a one year period.

Note 6: Response time for 0 psi to full scale span pressure step change

Note 7: If maximum pressure is exceeded, even momentarily, the package may leak or burst, or the pressure sensing die may fracture.

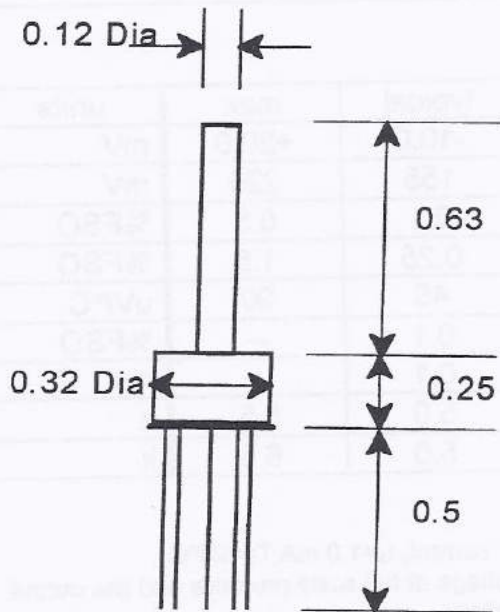
Electrical Connections

Pin	Function
1	Vsupply+
2	N/C
3	N/C
4	N/C
5	N/C
6	-Vout
7	Ground
8	+Vout



Pin Out (Bottom View)

Physical Dimensions (In inches)



Approximate Weight: 1 gram

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**6-PIN DIP ZERO-CROSS
OPTOISOLATORS TRIAC DRIVER OUTPUT
(250/400 VOLT PEAK)**

MOC3031M MOC3032M MOC3033M MOC3041M MOC3042M MOC3043M

DESCRIPTION

The MOC303XM and MOC304XM devices consist of a AlGaAs infrared emitting diode optically coupled to a monolithic silicon detector performing the function of a zero voltage crossing bilateral triac driver.

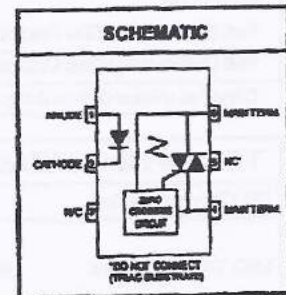
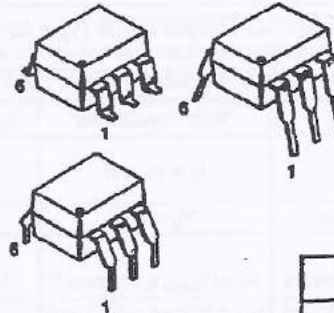
They are designed for use with a triac in the interface of logic systems to equipment powered from 115 VAC lines, such as teletypewriters, CRTs, solid-state relays, industrial controls, printers, motors, solenoids and consumer appliances, etc.

FEATURES

- Simplifies logic control of 115 VAC power
- Zero voltage crossing
- dv/dt of 2000 V/ μ s typical, 1000 V/ μ s guaranteed
- VDE recognized (File # 94766)
- ordering option V (e.g., MOC3043VM)

APPLICATIONS

- Solenoid/valve controls
- Static power switches
- Temperature controls
- AC motor starters
- Lighting controls
- AC motor drives
- E.M. contactors
- Solid state relays



ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ unless otherwise noted)				
Parameters	Symbol	Device	Value	Units
TOTAL DEVICE				
Storage Temperature	T_{STG}	All	-40 to +150	$^\circ\text{C}$
Operating Temperature	T_{OPR}	All	-40 to +85	$^\circ\text{C}$
Lead Solder Temperature	T_{SOL}	All	260 for 10 sec	$^\circ\text{C}$
Junction Temperature Range	T_J	All	-40 to +100	$^\circ\text{C}$
Isolation Surge Voltage ⁽¹⁾ (peak AC voltage, 60Hz, 1 sec duration)	V_{ISO}	All	7500	Vac(pk)
Total Device Power Dissipation @ 25 $^\circ\text{C}$ Derate above 25 $^\circ\text{C}$	P_D	All	250	mW
			2.94	mW/ $^\circ\text{C}$
EMITTER				
Continuous Forward Current	I_F	All	60	mA
Reverse Voltage	V_R	All	6	V
Total Power Dissipation 25 $^\circ\text{C}$ Ambient Derate above 25 $^\circ\text{C}$	P_D	All	120	mW
			1.41	mW/ $^\circ\text{C}$
DETECTOR				
Off-State Output Terminal Voltage	V_{DRM}	MOC3031M/2M/3M	250	V
		MOC3041M/2M/3M	400	
Peak Repetitive Surge Current (PW = 100 μ s, 120 pps)	I_{TSM}	All	1	A
Total Power Dissipation @ 25 $^\circ\text{C}$ Ambient Derate above 25 $^\circ\text{C}$	P_D	All	150	mW
		All	1.76	mW/ $^\circ\text{C}$

Note

1. Isolation surge voltage, V_{ISO} , is an internal device dielectric breakdown rating. For this test, Pins 1 and 2 are common, and Pins 4, 5 and 6 are common.

MOC3031M MOC3032M MOC3033M MOC3041M MOC3042M MOC3043M

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ Unless otherwise specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

Parameters	Test Conditions	Symbol	Device	Min	Typ	Max	Units
EMITTER							
Input Forward Voltage	$I_F = 30\text{ mA}$	V_F	All		1.25	1.5	V
Reverse Leakage Current	$V_R = 6\text{ V}$	I_R	All		0.01	100	μA
DETECTOR							
Peak Blocking Current, Either Direction	Rated V_{DRM} , $I_F = 0$ (note 1)	I_{DRM1}	All			100	nA
Peak On-State Voltage, Either Direction	$I_{TM} = 100\text{ mA peak}$, $I_F = 0$	V_{TM}	All		1.8	3	V
Critical Rate of Rise of Off-State Voltage	$I_F = 0$ (figure 9, note 3)	dv/dt	All	1000			V/ μs

TRANSFER CHARACTERISTICS ($T_A = 25^\circ\text{C}$ Unless otherwise specified.)

DC Characteristics	Test Conditions	Symbol	Device	Min	Typ	Max	Units
LED Trigger Current	Main terminal voltage = 3V (note 2)	I_{FT}	MOC3031M/MOC3041M			15	mA
			MOC3032M/MOC3042M			10	
			MOC3033M/MOC3043M			5	
Holding Current, Either Direction		I_H	All		400	μA	

ZERO CROSSING CHARACTERISTICS ($T_A = 25^\circ\text{C}$ Unless otherwise specified.)

Characteristics	Test Conditions	Symbol	Device	Min	Typ	Max	Units
Inhibit Voltage	$I_F = \text{rated } I_{FT}$, MT1-MT2 voltage above which device will not trigger off-state	V_{IH}	All			20	V
Leakage in Inhibited State	$I_F = \text{rated } I_F$, rated V_{DRM} , off-state	I_{DRM2}	All			500	μA

Note

1. Test voltage must be applied within dv/dt rating.
2. All devices are guaranteed to trigger at an I_F value less than or equal to max I_{FT} . Therefore, recommended operating I_F lies between max I_{FT} (15 mA for MOC3031M & MOC3041M, 10 mA for MOC3032M & MOC3042M, 5 mA for MOC3033M & MOC3043M) and absolute max I_F (60 mA).
3. This is static dv/dt . See Figure 9 for test circuit. Commutating dv/dt is a function of the load-driving thyristor(s) only.



LM35/LM35A/LM35C/LM35CA/LM35D Precision Centigrade Temperature Sensors

General Description

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of $\pm 1/4^\circ\text{C}$ at room temperature and $\pm 3/4^\circ\text{C}$ over a full -55 to $+150^\circ\text{C}$ temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only $60\ \mu\text{A}$ from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a -55° to $+150^\circ\text{C}$ temperature range, while the LM35C is rated for a -40° to $+110^\circ\text{C}$ range (-10° with improved accuracy). The LM35 series is

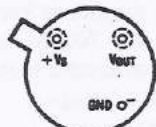
available packaged in hermetic TO-46 transistor packages, while the LM35C is also available in the plastic TO-92 transistor package.

Features

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guaranteeable (at $+25^\circ\text{C}$)
- Rated for full -55° to $+150^\circ\text{C}$ range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than $60\ \mu\text{A}$ current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only $\pm 1/4^\circ\text{C}$ typical
- Low impedance output, $0.1\ \Omega$ for 1 mA load

Connection Diagrams

TO-46
Metal Can Package*



BOTTOM VIEW

TL/H/5516-1

*Case is connected to negative pin

Order Number LM35H, LM35AH,
LM35CH, LM35CAH or LM35DH
See NS Package Number H03H

TO-92
Plastic Package



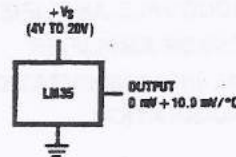
BOTTOM VIEW

TL/H/5516-2

Order Number LM35CZ or LM35DZ
See NS Package Number Z03A

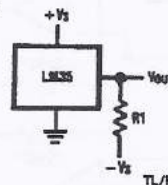


Typical Applications



TL/H/5516-3

FIGURE 1. Basic Centigrade Temperature Sensor ($+2^\circ\text{C}$ to $+150^\circ\text{C}$)

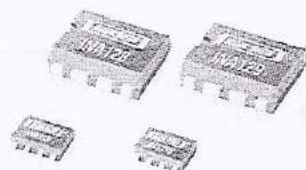


TL/H/5516-4

Choose $R_1 = -V_S/60\ \mu\text{A}$

$V_{OUT} = +1,500\ \text{mV}$ at $+150^\circ\text{C}$
 $= +250\ \text{mV}$ at $+25^\circ\text{C}$
 $= -550\ \text{mV}$ at -55°C

FIGURE 2. Full-Range Centigrade Temperature Sensor



INA128
INA129

Precision, Low Power INSTRUMENTATION AMPLIFIERS

FEATURES

- LOW OFFSET VOLTAGE: 50µV max
- LOW DRIFT: 0.5µV/°C max
- LOW INPUT BIAS CURRENT: 5nA max
- HIGH CMR: 120dB min
- INPUTS PROTECTED TO ±40V
- WIDE SUPPLY RANGE: ±2.25 to ±18V
- LOW QUIESCENT CURRENT: 700µA
- 8-PIN PLASTIC DIP, SO-8

APPLICATIONS

- BRIDGE AMPLIFIER
- THERMOCOUPLE AMPLIFIER
- RTD SENSOR AMPLIFIER
- MEDICAL INSTRUMENTATION
- DATA ACQUISITION

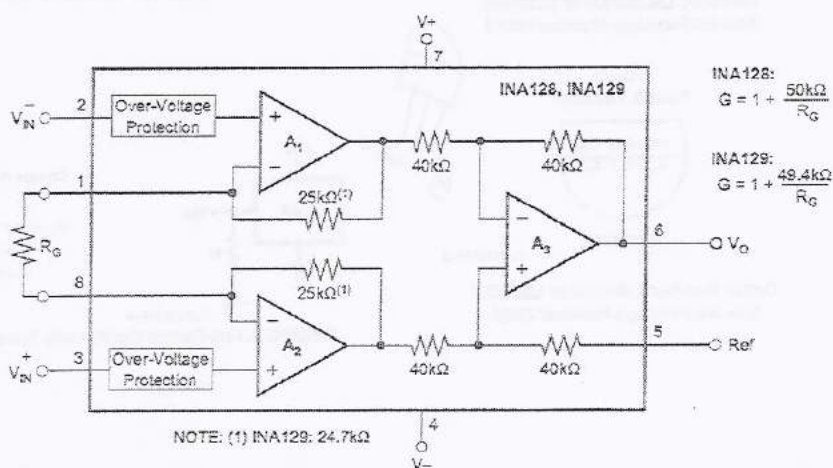
DESCRIPTION

The INA128 and INA129 are low power, general purpose instrumentation amplifiers offering excellent accuracy. Their versatile 3-op amp design and small size make them ideal for a wide range of applications. Current-feedback input circuitry provides wide bandwidth even at high gain (200kHz at $G = 100$).

A single external resistor sets any gain from 1 to 10,000. INA128 provides an industry standard gain equation; INA129's gain equation is compatible with the AD620.

The INA128/INA129 is laser trimmed for very low offset voltage (50µV), drift (0.5µV/°C) and high common-mode rejection (120dB at $G \geq 100$). It operates with power supplies as low as ±2.25V, and quiescent current is only 700µA—ideal for battery operated systems. Internal input protection can withstand up to ±40V without damage.

The INA128/INA129 is available in 8-pin plastic DIP, and SO-8 surface-mount packages, specified for the -40°C to +85°C temperature range. The INA128 is also available in dual configuration, the INA2128.



International Airport Industrial Park • Mailing Address: PO Box 11400, Tucson, AZ 85734 • Street Address: 6730 S. Tucson Blvd., Tucson, AZ 85706 • Tel: (520) 746-1111 • Tlx: 910-952-1111
Internet: <http://www.burr-brown.com/> • FAX Line: (800) 548-6133 (US/Canada Only) • Cable: BBRCORP • Telex: 986-6491 • FAX: (520) 869-1510 • Immediate Product Info: (800) 548-6132

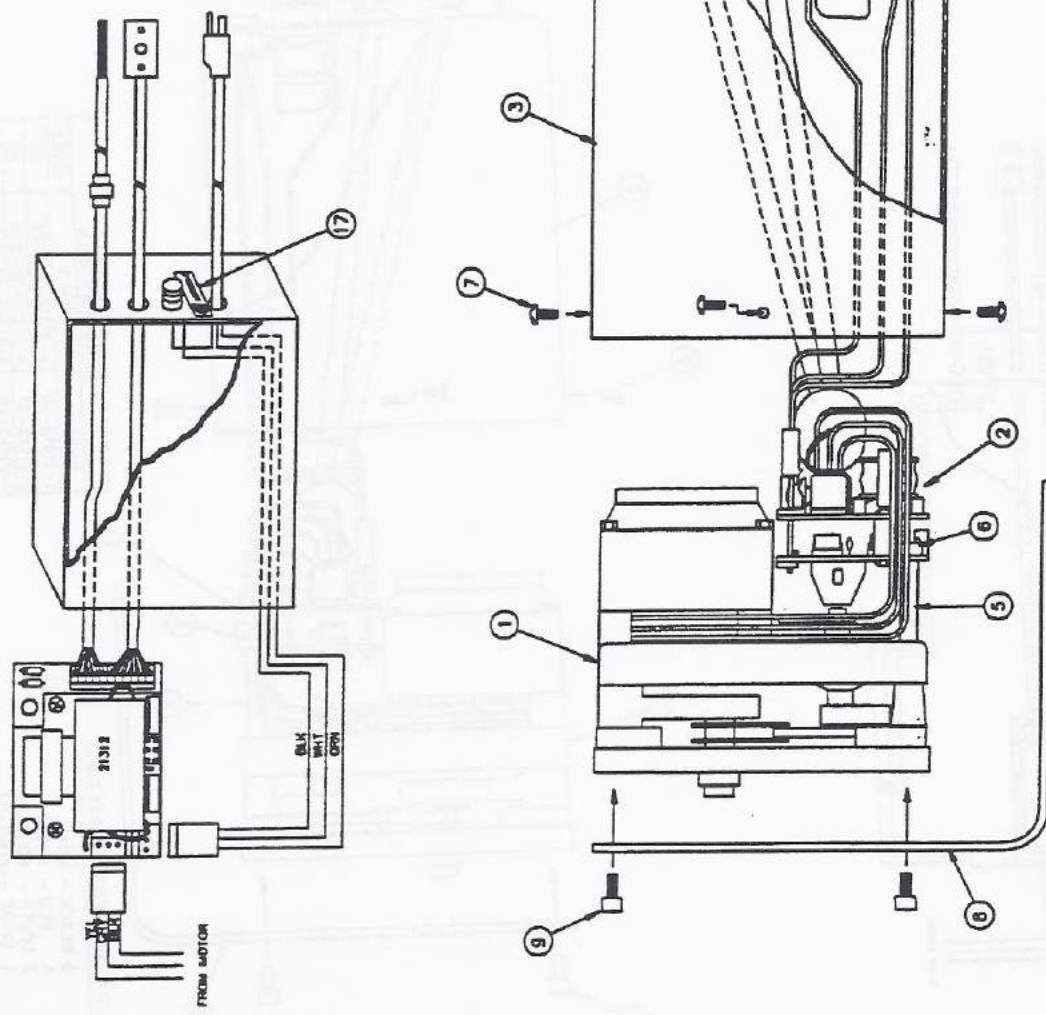
REVISIONS

REV	DESCRIPTION	DATE	APPROVED
1	REVISED TO SHOW VALCO P/N	11/1/69	AW
2	REVISED TO SHOW VALCO P/N	9/1/69	AW
3	REVISED TO SHOW VALCO P/N	5/1/69	AW
4	REVISED TO SHOW VALCO P/N	12/1/68	AW
5	REVISED TO SHOW VALCO P/N	12/1/68	AW

PARTS LIST

ITEM	DESCRIPTION	VALCO #	QTY
1	MOTOR ASSY. C-21358-00	SEE DASH SCH.	EA
2	ELECT. ACT. RD. ASSY. C-21312-01 rev P	I-21312-01	EA
3	COVER ASSY. C-21710-01	I-21710-01	EA
4	REMOTE INTERFACE CABLE ASSY B-21301	I-21301	EA
5	SPACER 1" LONG B-32 CLEARANCE	HWSP-0527	2 EA
6	SOCKET HEAD SCREW B-32 X 1 1/4"	HWSC-SCB-208	2 EA
7	SCREW PHILLIPS HD. 4-40 X 1/4"	HWSC-PL4-4	4 EA
8	BRACKET C-21308	I-21308	EA
9	B-32 3/8" SOCKET HEAD CAP SCREW	HWSC-SCB-09	EA
10	TAG REAR COVER A-21948	I-21948	EA
11	CONTROLLER ASSY. 2 POS	I-21360	EA
12	CONN. 4 POS SOC PANDUIT (NOT SHOWN)	I-1100724-8	EA
13	CABLE ASSY. REMOTE 2 POS 1 FT	I-21791-01	EA
14	CONN. 6 PIN MALE MOLEX	I-T03081062	EA
15	STRAIN RELIEF SRR-10	HWSRR-10	EA
16	STRAIN RELIEF SC24-4	HWSR24-4	EA
17	TAG, CSA CERTIFICATION	I-22627	EA
REF	SCHEMATIC B-21313		
REF	VIEW WITH DIMENSIONS C-21364		
REF	VALVE INSTALLATION (CL. MOUNT) B-21446		

NOTE: AFFIX TAG TO REAR OF COVER AFTER S/N, MODEL, AND VOLTS ARE RECORDED



DASH SCHEDULE

DASH	ITEM 1	ANGLE
I-21307-30	I-21358-30-110	30°
I-21307-36	I-21358-36-110	36°
I-21307-45	I-21358-45-110	45°
I-21307-60	I-21358-60-110	60°
I-21307-90	I-21358-90-110	90°

REMOTE INTERFACE CONNECTIONS

- 5 BLACK - LOAD
- 4 RED - INJECT
- 3 GREEN - COMMON
- 1 WHITE - CONTACT
- 2 SHIELD - CLOSURE

USE EXACTLY THE INFORMATION WHICH IS CONTAINED HEREIN FOR THE IDENTIFICATION OF THIS PRODUCT. THE INFORMATION CONTAINED HEREIN IS THE PROPERTY OF VALCO INSTRUMENTS CO., INC. AND SHALL BE RETURNED TO THE COMPANY UPON THE REQUEST OF THE COMPANY.

VALCO Instruments Co., Inc.
2 POSITION ELECTRIC
 ACT. ASSY. 110V
 I-21307

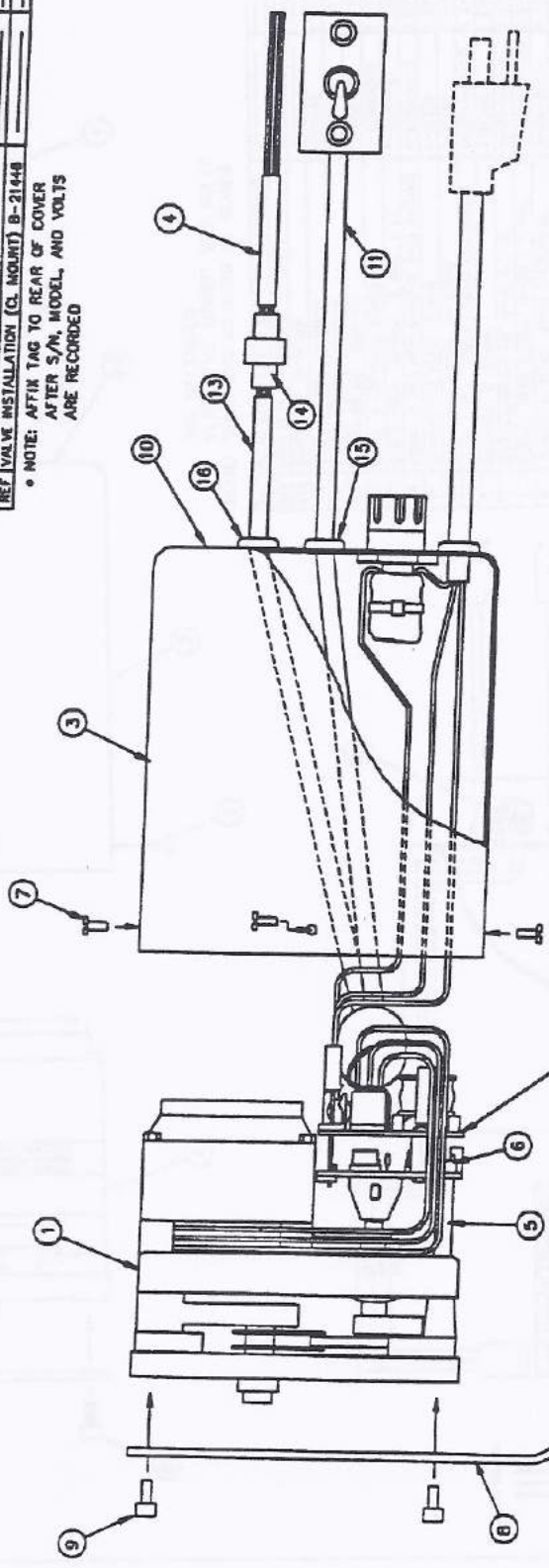
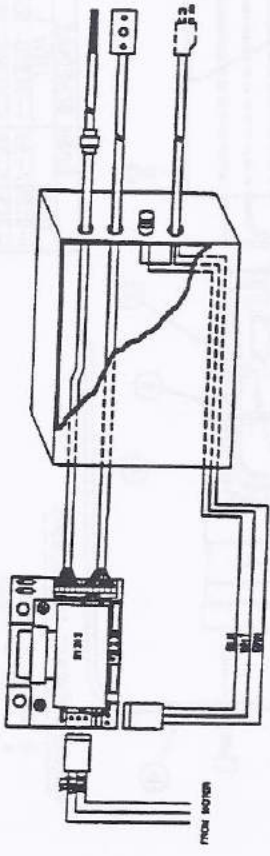
SCALE: --- C 21307

USA PRODUCTION B 1000

LIT	REV	DESCRIPTION	DATE	INITIALS
A	1	REV FOR BULKY 603 AND HWSC-208-08	10/1/58	JDM
B	2	REV FOR BULKY 603 AND HWSC-208-08	1-2-59	JDM
C	3	REV FOR BULKY 603 AND HWSC-208-08	1/25/59	JDM

ITEM	DESCRIPTION	VALCO #	QTY
1	MOTOR ASSY. C-21308-00	SEE DASH SCH.	1 EA.
2	ELECT. ACT. BD. ASSY. C-21312-01	21312-02	1 EA.
3	COVER ASSY. C-21710-01	21710-01	1 EA.
4	REMOTE INTERFACE CABLE ASSY B-21361	21361	1 EA.
5	SPACER 1" LONG B-32 CLEARANCE	HWSR-8527	2 EA.
6	SOCKET HEAD SCREW B-32 X 1 1/4"	HWSC-SCB-208	2 EA.
7	SCREW PHILLIPS HD. 4-40 X 1/4"	HWSC-PL4-4	4 EA.
8	BRACKET C-21308	21308	1 EA.
9	B-32 X 3/8" SOCKET HEAD CAP SCREW	HWSC-SCB-08	4 EA.
10	TAG REAR COVER A-21888	21888	1 EA.
11	CONTROLLER ASSY 2 POS	21380	1 EA.
12	CONN 8 POS SOC PANOULT (NOT SHOWN)	110074-8	1 EA.
13	CABLE ASSY REMOTE 2 POS 1 FT	21791-01	1 EA.
14	CONN 8 PIN MALE MOLEX	103081002	1 EA.
15	STRAIN RELIEF SPR-10	HWSRR-10	1 EA.
16	BRACKET C-21308	HWSR2M-4	1 EA.
17	REF SCHEMATIC B-21711		
18	REF VIEW WITH DIMENSIONS C-21306		
19	REF VALVE INSTALLATION (Q. MOUNT) B-21448		

* NOTE: AFFIX TAG TO REAR OF COVER AFTER S/N, MODEL, AND VOLTS ARE RECORDED



REMOTE INTERFACE CONNECTIONS
 5 BLACK - LOAD
 4 RED - INJECT
 3 GREEN - COMMON
 1 WHITE - CONTACT
 2 SHIELD - CLOSURE

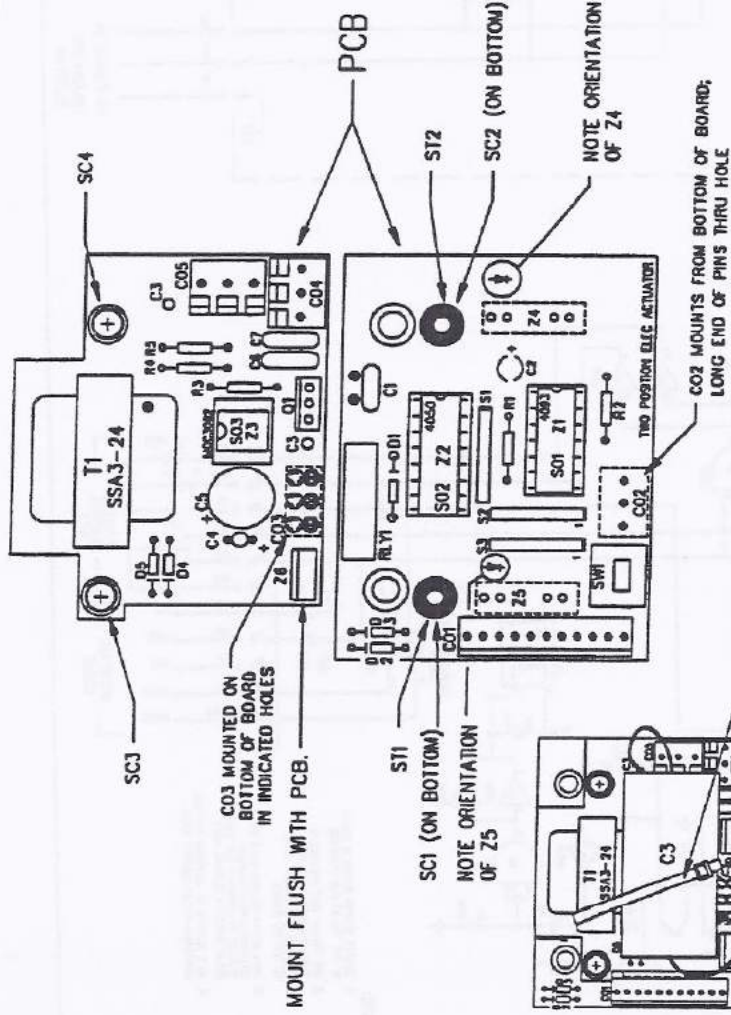
DASH	ITEM 1	ANGLE
I-21612-30	I-21358-30-220	30°
I-21612-36	I-21358-36-220	36°
I-21612-45	I-21358-45-220	45°
I-21612-60	I-21358-60-220	60°
I-21612-90	I-21358-90-220	90°

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VALCO Valco Instruments Co., Inc.
 2 POSITION ELECTRIC
 ACT. ASSY. 220V I-21612
 SCALE
 USA PRODUCTION C 21612

REVISIONS		DATE	APPROVED
1	REWORK FOR REV. 2 AND LATER BOARDS	10-26-83	J. CURRY
2	COMPONENTS LIST FOR REV. 2	11-28-83	
3	CON. #1548 LAY 28 DOWN ON BA.	11-2-83	

DES	DESCRIPTION	PART NUM	QTY
REF	SO-EMATIC (EA)DWG. 213130	21313	--
PCB	PCB ELEC. ACT. 2 POS REV. P (CSA)	I-PCB71311	1
C1	CAPACITOR .22mf 50V CERAM.	I-CC274-50	1
C2	CAPACITOR .47mf 35V TANI.	I-C1474-35	2
C3	CAPACITOR 20mf 250V POLY	I-CM205-250	1
C4	CAPACITOR 220mf 35V ELEC. RADIAL	I-CE227-35RL	1
C5	CAPACITOR 0.05mf 1KV CERAM. DISK	I-CC103-1K	1
C6	CAPACITOR 0.05mf 1KV CERAM. DISK	I-CC502-1K	1
C7	CAPACITOR 0.05mf 1KV CERAM. DISK	I-CC103-1K	1
CO1	CONNECTOR 3 PIN MOLEX (PC 51) 25-51-0031	I-1100-12	1
CO2	CONNECTOR 3 PIN MOLEX W/ RAMP 09851031	I-126510031	1
CO3	CONNECTOR 3 PIN PCB	I-109523033	1
CO4.5	CONNECTOR 3 PIN MOLEX W/ RAMP 09851031	I-126510032	2
D1,2,3	DIODE SIGNAL SILICON 1N914	I-D1N914	3
D4,5	DIODE RECTIFIER SILICON 1N4005	I-D1N4005	2
Q1	TRIAC 4 AMP 400V	I-06004.4	1
R1	RESISTOR 3.2 MEG. 5% 1/4 WATT	I-R512204	1
R2,3	RESISTOR .330 OHM 5% 1/4 WATT	I-R513300	2
R4	RESISTOR .27 OHM 5% 1/4 WATT	I-R512700	1
R5	RESISTOR .39 OHM 5% 1/4 WATT	I-R513900	1
S1	SP. RESISTOR NET 750-61-330	I-RN750-61-331	1
S2	SP. RESISTOR NET 750-63-076	I-RN750-63-076	1
S3	SP. RESISTOR NET 750-63-102	I-RN750-63-102	1
SC1-4	SCREW PLMS: 4-40X1/16	HW5C-PL4-4	4
ST1,2	STANDOFF THREADED 4-40 x .5	HW50-2372	2



PART # FOR 110V. UNITS - I-21312-01
 PART # FOR 220V. UNITS - I-21312-02
 (SEE NOTE 3)

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 FINISHES ARE AS SHOWN
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APPROVED: _____ DATE: 10/28/83
 DRAWN BY: MARY HANLIN
 CHECKED BY: MARY HANLIN

VALCO Valco Instruments Co., Inc.
 BOARD ASSY. REV-P
 TWO POS. ELE ACT I-21312
 SCALE: --- B 21312
 USA PROTECTION B SHEET OF

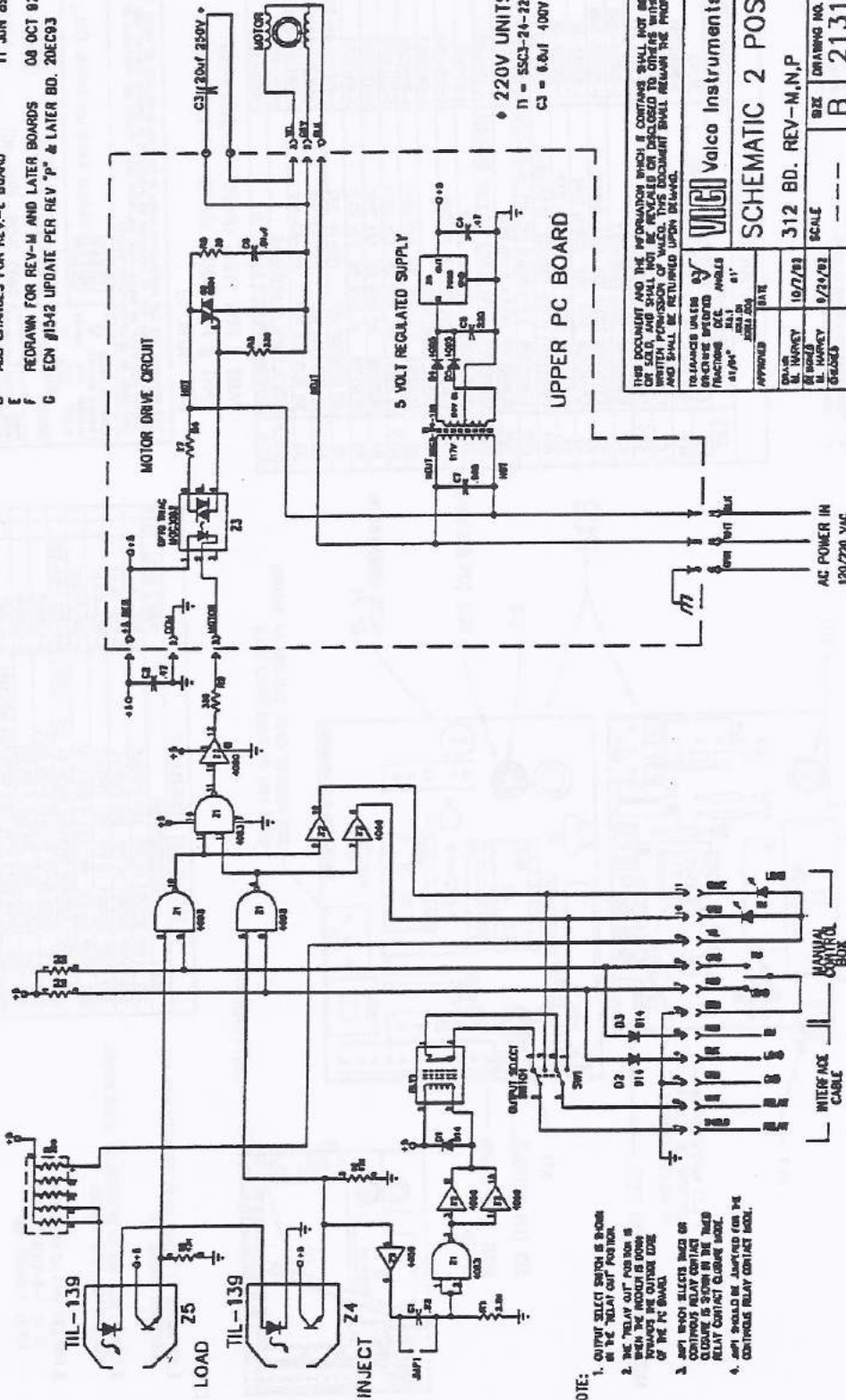
REF	DESCRIPTION	PART NUM	QTY
S01	DIP SOCKET 14 PIN LOW PROFILE	I-TDS-14-LP	1
S02	DIP SOCKET 16 PIN LOW PROFILE	I-TDS-16-LP	1
S03	DIP SOCKET 6 PIN LOW PROFILE	I-TDS-6-LP	1
SW1	DIP SWITCH GRAYHILL 6 PIN DPDT	I-SW-76SDGT	1
T1	TRANSFORMER PARALINE S5C3-24 120VAC	I-X-S5C3-24-120	1
Z1	IC CMOS QUAD SCHMITT NAND GATE	I-C4093	1
Z2	IC CMOS HEX BUFFER / DRIVER	I-C4050	1
Z3	IC OPTO TRIAC WITH ZERO CROSSING	I-C3082	1
Z4,5	OPTO DETECTOR REFLECTIVE TYPE TL139 OR EQ	I-CTL139	2
Z8	THREE TERM VOLTAGE REGULATOR 5 VOLT 7805	I-C7805	1
RLY1	RELAY, HAMILIN	I-RY-HAMLIN	1

NOTE:

- CAPACITOR C3 LEADS TO BE SOLDERED INTO THE LOCATIONS MARKED "C3"
- SCREWS SC3, SC4 TO BE INSTALLED AFTER BOARDS ARE REMOVED FROM CARRIER
- FOR 220 VOLT AC UNITS CHANGE -
 T1 to I-X-S5C3-24-220
 C3 to I-DM685-400

REVISIONS

LTN	DESCRIPTION	DATE	APPROVED
A	REDRAWN FOR REV. H AND LATER BOARDS	8-1-88	
B	CHANGE VALUE OF C3 FROM 10uF TO 20uF	5/20/88	
C	CORRECT MINOR ERRORS	04 OCT 89	J. DURR
D	ADD CHANGES FOR REV.-I BOARD	11 JUN 89	
F	REDRAWN FOR REV.-M AND LATER BOARDS	08 OCT 82	MARC HARVEY
G	ECH #1542 UPDATE PER REV "P" & LATER BD. 20DEC93		J DURR



220V UNITS USE:
 I1 = 55C3-24-220
 C3 = 6.0uF 100V

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VI Vaico Instruments Co., Inc.
 SCHEMATIC 2 POS ACTU.
 312 BD. REV.-M,N,P 110V-220V
 SCALE --- B 21313
 USA PROTECTION B SHEET OF

APPROVED	DATE
M. HARVEY	10/7/83
J. DURR	9/25/82

RESISTANCE VALUES IN OHMS UNLESS OTHERWISE SPECIFIED
 CAPACITANCE VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED

- NOTE:
1. OUTPUT SELECT SWITCH IS DOWN AT THE "RELAY OUT" POSITION.
 2. THE "RELAY OUT" POSITION IS WHEN THE MOTOR IS DOWN THROUGH THE OUTPUT LINE OF THE PC BOARD.
 3. J401 WHICH SELECTS INCH OR CONTINUOUS RELAY CONTACT CLOSURE IS SHOWN IN THE "NEED RELAY CONTACT CLOSURE" MODE.
 4. J401 SHOULD BE JUMPED FOR THE CONTINUOUS RELAY CONTACT MODE.

Timers for Timing Delays and Oscillator Applications in Commercial, Industrial and Military Equipment

March 1993

Features

- Accurate Timing from Microseconds through Hours
- Astable and Monostable Operation
- Adjustable Duty Cycle
- Output Capable of Sourcing or Sinking up to 200mA
- Output Capable of Driving TTL Devices
- Normally ON and OFF Outputs
- High Temperature Stability 0.005%/°C
- Directly Interchangeable with SE555, NE555, MC1555, and MC1455

Applications

- Precision Timing
- Sequential Timing
- Time Delay Generation
- Pulse Generation
- Pulse Detector
- Pulse Width and Position Modulation

Ordering Information

PART NO.	TEMP. RANGE	PACKAGE
CA0555E	-55°C to +125°C	8 Lead Plastic DIP
CA0555M	-55°C to +125°C	8 Lead SOIC
CA0555M96	-55°C to +125°C	8 Lead SOIC*
CA0555T	-55°C to +125°C	8 Pin TO-5 Metal Can
CA0555CE	0°C to +70°C	8 Lead Plastic DIP
CA0555CM	0°C to +70°C	8 Lead SOIC
CA0555CM96	0°C to +70°C	8 Lead SOIC*
CA0555CT	0°C to +70°C	8 Pin TO-5 Metal Can
LM555N	0°C to +70°C	8 Lead Plastic DIP
LM555CN	0°C to +70°C	8 Lead Plastic DIP

* Denotes Tape and Reel

Description

The CA555 and CA555C are highly stable timers for use in precision timing and oscillator applications. As timers, these monolithic integrated circuits are capable of producing accurate time delays for periods ranging from microseconds through hours. These devices are also useful for astable oscillator operation and can maintain an accurately controlled free running frequency and duty cycle with only two external resistors and one capacitor.

The circuits of the CA555 and CA555C may be triggered by the falling edge of the waveform signal, and the output of these circuits can source or sink up to a 200mA current or drive TTL circuits.

These types are direct replacements for industry types in packages with similar terminal arrangements e.g. SE555 and NE555, MC1555 and MC1455, respectively. The CA555 type circuits are intended for applications requiring premium electrical performance. The CA555C type circuits are intended for applications requiring less stringent electrical characteristics.

Technical data on LM branded types is identical to the corresponding CA branded types.

MOUSER ELECTRONICS

NORTHERN CALIFORNIA

370 TOMKINS CT.

GILROY, CA 95020

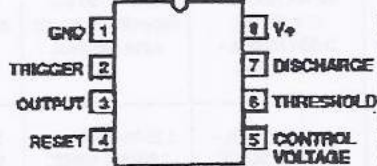
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FAX: (408) 842-7375

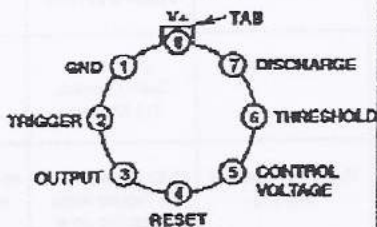
1-12 4590

Pinouts

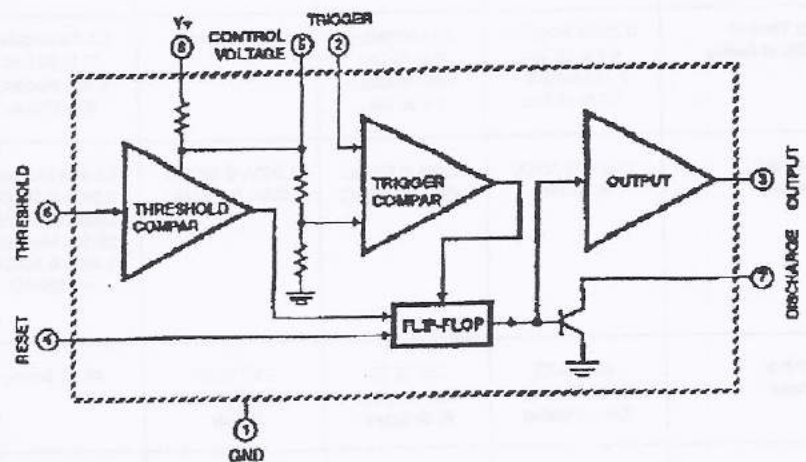
CA555, CA555C, LM555C (PDIP, SOIC)
TOP VIEW



TO-5 Style Package with Formed Leads
CA555, CA555C, LM555C (METAL CAN)
TOP VIEW






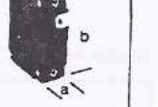










Functional Diagram



SPECIAL ANA.

Circuit Breakers

			NEW 			NEW DESIGN 	NEW DESIGN 
Series	W28	W58	W33	W23	W31	W6	W9
Type	Thermal	Thermal	Thermal	Thermal	Thermal	Magnetic	Magnetic
Features	<ul style="list-style-type: none"> Replaces slow blow glass cartridge fuse and holder Labor-saving snap-in mounting Button extends for visible trip indication Push-to-reset operation 	<ul style="list-style-type: none"> Quick connect or screw terminals Button extends for visible trip indication Push-to-reset operation 	<ul style="list-style-type: none"> Rocker actuator in various colors Convenient, snap-in mounting Optional lighted rockers Models with aux. switch available Designed to meet IEC and VDE requirements. 	<ul style="list-style-type: none"> Push/pull actuation for manual on/off and reset 	<ul style="list-style-type: none"> Toggle actuation for manual on/off and reset 	<ul style="list-style-type: none"> Compact design Variety of time delay options Toggle actuation for manual on/off and reset Optional aux. switch 	<ul style="list-style-type: none"> Variety of time delay options Toggle actuation for manual on/off and reset Optional aux. switch
							
Approximate Size and Weight (per pole)	a b c .54" x .63" x 1.54"d (13.7 x 15.9 x 39.0d) .35 oz. (10g)	a b c .66" x 1.38" x 1.38"d (16.8 x 34.9 x 34.9d) 1.5 oz. (43g)	a b c .98" x 1.89" x 1.72"d (24.9 x 48 x 43.8d) 1.2 oz. (35g)	a b c .69" x 1.38" x 1.6"d (17.5 x 34.9 x 40.6d) 2 oz. (57g)	a b c .69" x 1.38" x 1.6"d (17.5 x 34.9 x 40.6d) 2 oz. (57g)	a b c .75" x 2.0" x 1.64"d (19.1 x 50.8 x 42.1d) 2.5 oz. (71g)	a b c .75" x 2.5" x 2.1"d (19.1 x 63.5 x 53.0d) 2.5 oz. (71g)
No. of Poles	1	1	1 or 2	1	1	1 through 4	1 through 4
Circuit Function	Series Trip	Series Trip	Series Trip, both poles or Series Trip, one pole: Switch only, one pole	Series Trip	Series Trip	Series Trip w/ or w/o Aux. Switch, Shunt Trip, Relay Trip, Dual Coil Series Trip, Dual Coil Shunt Trip	Series Trip w/ or w/o Aux. Switch, Shunt Trip, Relay Trip, Dual Coil Series Trip, Dual Coil Shunt Trip
Current Rating	0.25-20 Amps	1-35 Amps	5-20 Amps	0.5-50 Amps	0.5-50 Amps	0.25-50 Amps	0.25-50 Amps
Max. Operating Voltage	32VDC 250VAC	50VDC 250VAC	50VDC 250VAC	50VDC 250VAC	50VDC 250VAC	65VDC 277VAC 480VAC 3a-Wye	65VDC 277VAC 480VAC 3a-Wye
Trip Time at 200% of Rating	0.25-2A Models - 4.5 to 28 Sec. 3-15A Models - 2.2 to 15 Sec.	1-4A Models - 10 to 45 Sec. 5-35A Models - 6 to 30 Sec.	10 to 30 Sec.	0.5-4A Models - 11 to 30 Sec. 5-35A Models - 6 to 22 Sec.	0.5-4A Models - 11 to 30 Sec. 5-35A Models - 6 to 22 Sec.	30ms to 150 Sec. depending upon trip curve specified.	30ms to 150 Sec. depending upon trip curve specified.
Interrupt Capacity	1,000A @ 32VDC or 250VAC	2,000A @ 50VDC 1,000A @ 250VAC	1,000A @ 50VDC 2,000A @ 250VAC	0.5-25A Models - 2,000A @ 50VDC 1,000A @ 250VAC 30-50A Models - 1,000A @ 50VDC or 250VAC	0.5-25A Models - 2,000A @ 50VDC 1,000A @ 250VAC 30-50A Models - 1,000A @ 50VDC or 250VAC	0.25-20A Models - 2,000A @ 65VDC 5,000A @ 277VAC or 480VAC 3a-Wye 21-50A Models - 2,000A @ 65VDC 2,500A @ 277VAC	2,000A @ 65VDC 5,000A @ 277VAC 5,000A @ 480VAC 3a-Wye
Terminal Options	.250" (6.35) Quick Connect (Do not solder)	.250" (6.35) Quick Connect, #6-32 Screw	.250" (6.35) Quick Connect, Solder	#6-32 Screw	#6-32 Screw	.250" (6.35) Quick Connect, #10-32 Screw	#10-32 Stud
Mounting Options	Snaps into 5/8" (15.9) panel cutout from the front	7/16"-28 Threaded Bushing, 15/32"-32 Threaded Bushing	Snaps into .875 x 1.75" (22.2 x 44.5) panel cutout from the front	3/8"-24 Threaded Bushing	15/32"-32 Threaded Bushing	#6-32 Tapped Holes, M3 Tapped Holes, Snaps into panel cutout from the front	#6-32 Tapped Holes, M3 Tapped Holes
Page Number	22	24	27	29	29	32	32

Specifications and/or agency recognitions do not necessarily apply to all models within a particular series. When multiple ratings are listed, no individual rating may be exceeded by the combination of others.



LM138A/LM138, LM338A/LM338 5-Amp Adjustable Regulators

General Description

The LM138 series of adjustable 3-terminal positive voltage regulators is capable of supplying in excess of 5A over a 1.2V to 32V output range. They are exceptionally easy to use and require only 2 resistors to set the output voltage. Careful circuit design has resulted in outstanding load and line regulation—comparable to many commercial power supplies. The LM138 family is supplied in a standard 3-lead transistor package.

A unique feature of the LM138 family is time-dependent current limiting. The current limit circuitry allows peak currents of up to 12A to be drawn from the regulator for short periods of time. This allows the LM138 to be used with heavy transient loads and speeds start-up under full-load conditions. Under sustained loading conditions, the current limit decreases to a safe value protecting the regulator. Also included on the chip are thermal overload protection and safe area protection for the power transistor. Overload protection remains functional even if the adjustment pin is accidentally disconnected.

Normally, no capacitors are needed unless the device is situated more than 6 inches from the input filter capacitors in which case an input bypass is needed. An output capacitor can be added to improve transient response, while bypassing the adjustment pin will increase the regulator's ripple rejection.

Besides replacing fixed regulators or discrete designs, the LM138 is useful in a wide variety of other applications. Since the regulator is "floating" and sees only the input-to-output differential voltage, supplies of several hundred volts can be

regulated as long as the maximum input to output differential is not exceeded, i.e., do not short-circuit output to ground. The part numbers in the LM138 series which have a K suffix are packaged in a standard Steel TO-3 package, while those with a T suffix are packaged in a TO-220 plastic package. The LM138A/LM138 are rated for $-55^{\circ}\text{C} \leq T_J \leq +150^{\circ}\text{C}$, while the LM338A is rated for $-40^{\circ}\text{C} \leq T_J \leq +125^{\circ}\text{C}$, and the LM338 is rated for $0^{\circ}\text{C} \leq T_J \leq +125^{\circ}\text{C}$.

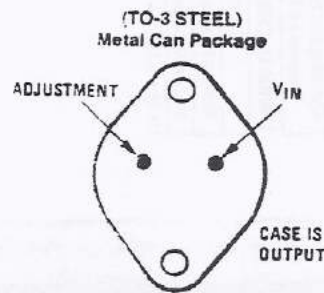
Features

- Guaranteed 7A peak output current
- Guaranteed 5A output current
- Adjustable output down to 1.2V
- Guaranteed thermal regulation
- Current limit constant with temperature
- 100% electrical burn-in in thermal limit
- Output is short-circuit protected
- Guaranteed 1% output voltage tolerance (LM138A, LM338A)
- Guaranteed max. 0.01%/V line regulation (LM138A, LM338A)
- Guaranteed max. 0.3% load regulation (LM138A, LM338A)

Applications

- Adjustable power supplies
- Constant current regulators
- Battery chargers

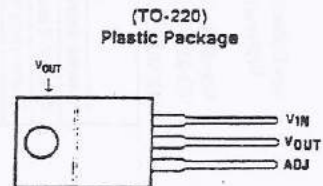
Connection Diagrams (See Physical Dimension section for further information)



Bottom View

Order Number LM138AK STEEL/LM138K STEEL/
LM338AK STEEL/LM338K STEEL
See NS Package Number K02A

TL/H/9080-30



Front View

Order Number LM338AT/LM338T
See NS Package Number T03B

TL/H/9080-31

Plastic Medium-Power Complementary Silicon Transistors

... designed for general-purpose amplifier and low-speed switching applications.

- High DC Current Gain —
 $h_{FE} = 2500$ (Typ) @ $I_C = 4.0$ Adc
 Collector-Emitter Sustaining Voltage — @ 30 mAdc
 $V_{CE(sus)} = 60$ Vdc (Min) — TIP100, TIP105
 $= 80$ Vdc (Min) — TIP101, TIP106
 $= 100$ Vdc (Min) — TIP102, TIP107
- Low Collector-Emitter Saturation Voltage —
 $V_{CE(sat)} = 2.0$ Vdc (Max) @ $I_C = 3.0$ Adc
 $= 2.5$ Vdc (Max) @ $I_C = 8.0$ Adc
- Monolithic Construction with Built-In Base-Emitter Shunt Resistors
- TO-220AB Compact Package

*MAXIMUM RATINGS

Rating	Symbol	TIP100, TIP105	TIP101, TIP106	TIP102, TIP107	Unit
Collector-Emitter Voltage	V_{CE}	60	80	100	Vdc
Collector-Base Voltage	V_{CB}	60	80	100	Vdc
Emitter-Base Voltage	V_{EB}	5.0			Vdc
Collector Current — Continuous Peak	I_C	8.0	8.0	15	Adc
Base Current	I_B	1.0			Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	PD	80	80	80	Watts W/ $^\circ\text{C}$
Unclamped Inductive Load Energy (1)	E	30			mJ
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C	PD	2.0	2.0	2.0	Watts W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +150			$^\circ\text{C}$

THERMAL CHARACTERISTICS

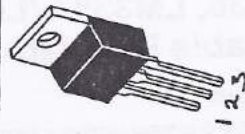
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.56	$^\circ\text{C/W}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	62.5	$^\circ\text{C/W}$

(1) $I_C = 1.1$ A, $L = 50$ mH, P.R.F. = 10 Hz, $V_{CC} = 20$ V, $R_{BE} = 100 \Omega$

NPN
TIP100*
TIP101*
TIP102*
PNP
TIP105
TIP106*
TIP107*

*Motorola Preferred Device

DARLINGTON
8 AMPERE
COMPLEMENTARY SILICON
POWER TRANSISTORS
60-80-100 VOLTS
80 WATTS



1 2 3
 CASE 221A-06
 TO-220AB

PIN 1 = BASE
 2 = COL
 3 = EMIT.

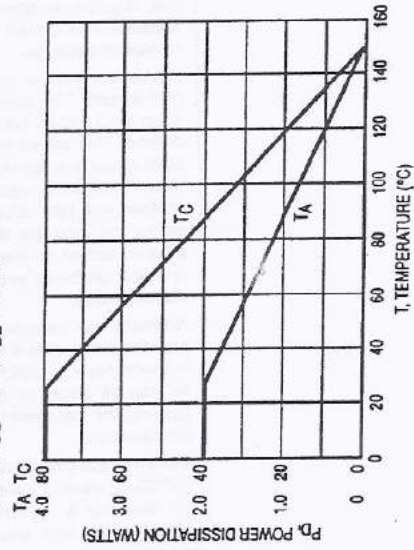


Figure 1. Power Derating

Preferred devices are Motorola recommended choices for future use and best overall value.
 REV 7

108 - 10.0/10.6 eV

Glow Discharge Photoionization Detection Lamp (PID) - Model 108

From the
"Pioneers of PID™"

Scientific Services Co., Inc.
P. O. Box 317, Rocky Hill, NJ 08553

108-10.0/10.6

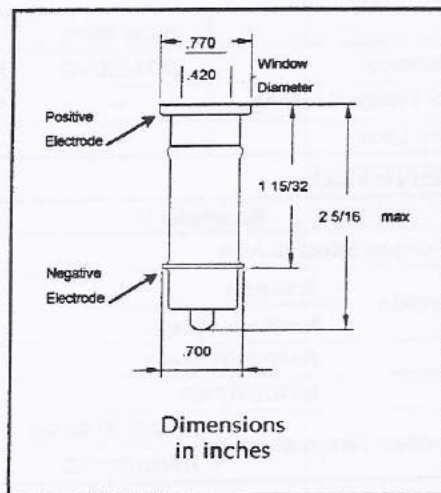
The most popular of our line of PID lamps is the Model 108-10.0/10.6. This model is used in all PID detectors employing glow discharge lamps with the exception of the HNU type*. This Model 108 utilizes a small and efficient envelope (see Dimensional Drawing below). The VUV energy is emitted in spectral lines at 10.0 eV to 10.6 eV.

(*For HNU style instruments, see our original PID lamp Model 103)

Photograph of Model 108



Dimensional Drawing



Order by calling 609-921-3358 or fax
Purchase Order to 609-921-2549

For more product information, see our
web site at www.sciserv.com or email us
at info@sciserv.com

"Pioneers of PID" is a trademark of Scientific Services Co., Inc.

Product Warranty

Only Scientific Services offers a three month warranty, provided normal operation does not exceed 1 ma at 250° C. This applies whether purchased direct from us or from one of our distributors. (Excludes Model 109-11.3)

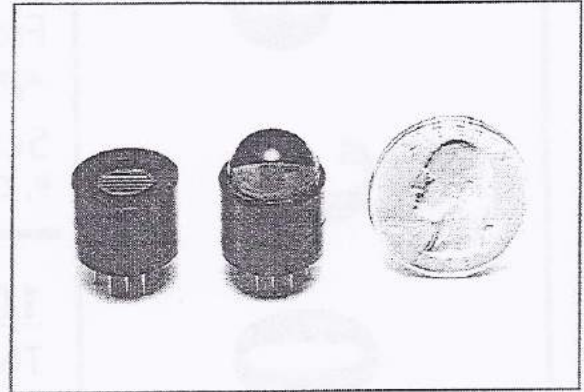
April 1998

HAMAMATSU

METAL PACKAGE PHOTOMULTIPLIER TUBE R7400U SERIES

**Compact size (16mm diameter, 12mm seated length),
Fast Time response (rise time 0.78ns)**

The R7400U series is a subminiature photomultiplier tube with a 16mm diameter and 12mm seated length. A precision engineered 8-stage electron multiplier (composed of metal channel dynodes) is incorporated in the TO-8 package to produce a noise free gain of 700,000 times (R7400U). Its improved metal channel dynode design increases photoelectron collections efficiency by 30% than the previous type. The R7400U series also features excellent response time with a rise time of 0.78ns. Various types of the R7400U series are available with different spectral response and gain ranges, including those selected specifically for photon counting applications. Hamamatsu also provides a hemispherical lens input option to the series (R7401 and R7402), effectively doubling the active area.



Left: R7400U Right: R7401/R7402

FEATURES

- World's smallest photomultiplier tubes assembled in a TO-8 metal package (1/7th of the Hamamatsu R647).
The necessary components are built into a TO-8 package while retaining full photomultiplier tube performance to create a new generation of photosensors.
- Increased photoelectron collection efficiency.
The improved metal-channel dynode delivers photoelectron collection efficiency 30% higher than former types R5600U.
- Photon counting types: R7400P series.
The R7400P series is specially selected on account of low noise and high gain for use in photon counting applications.
- Hemispherical lens window types: R7401 (bialkali), R7402 (multialkali).
The hemispherical lens window doubles the effective input area to 12mm in diameter.

SERIES

	Solar Blind	UV to Visible Range	UV to Near IR Range	Insulation Cover
Standard	R7400U-09	R7400U/R7400U-03/R7400U-06	R7400U-01/R7400U-02/R7400U-04	Yes
For Photon Counting	—	R7400P/R7400P-03/R7400P-06	R7400P-01/R7400P-04	Yes
With Lens	—	R7401 (Visible Range)	R7402 (Visible to Near IR Range)	Yes

GENERAL

Parameter		Description/Value	Unit
Minimum Effective Area		8	mm ϕ
Dynode	Structure	Metal Channel	—
	Number of Stage	8	—
Weight	R7400U/P Series	Approx. 5.3	g
	R7401/R7402	Approx. 6.3	
Ambient Temperature	R7400U/P Series	-80 to +50	°C
	R7401/R7402	-30 to +50	

VOLTAGE DISTRIBUTION RATIO

Electrodes	K	Dy1	Dy2	Dy3	Dy4	Dy5	Dy6	Dy7	Dy8	P
Ratio	1	1	1	1	1	1	1	1	1	0.5

Supply Voltage: 800V K: Cathode Dy: Dynode P: Anode

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