OPERATION AND MAINTENANCE

MANUAL FOR MODEL 300 HFID/MHFID ANALYZER

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Website: www.gasanalyzers.com

MODEL 300 HFID/MHFID

HEATED HYDROCARBON ANALYZER

INSTRUCTION MANUAL

This manual describes the installation, calibration and operation of California Analytical Instruments, Inc. Model 300 HFID and Model 300M HFID Heated Total Hydrocarbon Gas Analyzer.

To assure correct operation and accurate results, it is recommended that the user carefully read this document.

June, 2003

Version B.031

P/N 970040

MODEL 300 HFID INSTRUCTION MANUAL

$25.00 EACH

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1. INTRODUCTION

1.1. Overview

Thank you and congratulations! You have just purchased one of the most reliable gas analyzers in the world. Before using the analyzer, please familiarize yourself with its operation by reading this manual. If you have any questions, please do not hesitate to call California Analytical Instruments for assistance. We want you to be a member of our thousands of satisfied customers.

1.2. Unpacking Instructions

Open the shipping container and carefully remove the analyzer from the packing materials. Inspect the instrument for any sign of damage. Remove the retaining screws and lift off the cover panel. Visually check for proper seating of parts and or connectors. If all internal components appear to be normal replace the cover and secure it with the screws previously removed.

1.3. Reporting Damage

Should there be any apparent damage either to the inside or outside of the instrument due to shipping or handling, notify the shipper immediately. Retain the shipping container or packing materials for inspection by the shipper.

1.4. Contact Information

California Analytical Instruments, Inc.
1312 West Grove Avenue
Orange, CA 92865
714 974-5560
Fax 714 921-2531
Website: www.gasanalyzers.com

1.5. Warranty Certificate

Subject to the exceptions and upon the conditions stated below, California Analytical Instruments (CAI) warrants that the products sold under this sales order shall be free from defects in workmanship and materials for one year after delivery of the product to the original Buyer by CAI and if any such product should prove to be defective within such one year period, CAI agrees, at its option, either (i) to correct by repair or, at CAI's election, by replacement with equivalent product any such defective product, provided that investigation and factory inspection discloses that such defect developed under normal and proper uses, or (ii) to refund the purchase price. The exceptions and conditions mentioned above are as follows:

a) components or accessories manufactured by CAI that by their nature are not intended to or will not function for one year are warranted only to give reasonable service for a reasonable time. What constitutes reasonable time and reasonable services shall be determined solely by CAI. A complete list of such components and accessories is maintained at the factory;

b) CAI makes no warranty with respect to components or accessories not manufactured by it; in the event of defect in any such component or accessory CAI will give reasonable assistance to Buyer in obtaining from the respective manufacturer whatever adjustment is authorized by the manufacturer's warranty;

c) any product claimed to be defective must be returned to the factory transportation charges prepaid and CAI will return the repaired or replaced product freight collect;

d) if the product claimed to be defective requires on-site repair, such warranty labor will be provided at no charge; however, transportation and living expenses will be charged to Buyer;

e) if the product is a consumable or the like, it is warranted only to conform to the quantity and content and for the period (but not in excess of one year) stated on the label at the time of delivery or 90 days;

f) CAI may from time to time provide a special printed warranty with respect to a certain product, and where applicable, such warranty shall be deemed incorporated herein by reference;

g) CAI shall be released from all obligations under all warranties, either expressed or implied, if any product covered hereby is repaired or modified by persons other than its own authorized service personnel unless such repair by others is made with the written consent of CAI.

IT IS EXPRESSLY AGREED THAT THE ABOVE WARRANTY SHALL BE IN LIEU OF ALL WARRANTIES OF FITNESS AND OF THE WARRANTY OF MERCHANTABILITY AND THAT CAI SHALL HAVE NO LIABILITY FOR SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND OR FROM ANY CAUSE WHATSOEVER ARISING OUT OF THE MANUFACTURE USE, SALE, HANDLING, REPAIR, MAINTENANCE OR REPLACEMENT OF ANY OF THE PRODUCTS SOLD UNDER THIS SALES ORDER. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THAT THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY HAVE OTHER RIGHTS, WHICH VARY FROM STATE TO STATE.

Representations and warranties made by any person, including dealers and representatives of CAI which are inconsistent or in conflict with the terms of this warranty, shall not be binding upon CAI unless produced in writing and approved by an expressly authorized officer of CAI.

Danger

1.6. Possible Explosion Hazard

Do not apply power to the analyzer or attempt to ignite the burner until performing ALL leak checks and until determining the analyzer environment to be non-hazardous.

Use this analyzer in **a NON-HAZARDOUS** environment.

This analyzer uses a fuel that contains a **FLAMMABLE LEVEL OF HYDROGEN**. Any leakage from this fuel can result in an explosion. Carefully check the fuel supply system, both inside and outside the analyzer for leaks upon installation, before initial start-up, during any maintenance: or after the integrity of the system is broken.

This analyzer has not been designed for use with a hazardous sample.

Tampering or use of substitute components may cause a safety hazard. Use only factory authorized replacement parts.

1.7. Electrical Shock Hazard

Do not operate without the cover secured. Servicing requires access to live electrical components that can cause death or serious injury. Refer servicing to qualified service personnel. For safety and proper performance, connect this instrument to a properly grounded three-wire receptacle.

Caution

1.8. Fuel Requirements

The CAI factory configures the Model 300 HFID/MHFID for either 100% Hydrogen or 40%/60% Hydrogen/Helium Fuel. Please make sure to use the **CORRECT** fuel.

Use of **INCORRECT** fuel will **DAMAGE** the instrument and could cause an **EXPLOSION**.

1.9. Potential Sample Pump Damage

For applications that require injection of calibration gas via the sample port of the analyzer, it is **MANDATORY** that pressures do not exceed **2.0 PSIG** pressure. Damage sustained by the

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Plug Removal

Do not operate this analyzer UNTIL REMOVING the red plastic ¼ inch plugs from the sample/zero/span/fuel fittings on the rear panel.

1.10. FACTORY QA CHECKOUT SHEET

FID SERIAL NUMBER: _____

FACTORY AIR PRESSURE SETTING: _____

FACTORY FUEL PRESSURE SETTING: _____

FACTORY SAMPLE PRESSURE SETTING: _____

2. FEATURES AND PRINCIPLES OF OPERATION

2.1. Description

The CAI Model 300 HFID Heated Total Hydrocarbon Analyzer utilizes a highly sensitive flame ionization detector (FID) gas analyzer for measuring gas concentrations in industrial and vehicle emission applications.

The CAI Model 300 MHFID Heated Total Hydrocarbon Analyzer is exactly the same instrument as the Model 300 HFID, except that it contains a catalyst that may be switched in and out of the sample stream, with the front panel switch or via a contact closure, to analyze the methane content of the sample. This catalyst (Methane Cutter) removes all hydrocarbons from the sample stream except methane.

The heated sample gas is maintained above the dew point by a self contained internal adjustable temperature oven. The oven temperature may be adjusted between 60 and 200 degrees C. The sample gas is maintained at an elevated temperature until it exits the FID burner assembly. This prevents any loss of hydrocarbon concentration in the sample due to condensation.

The instrument contains a front panel, nine position, range switch which allows the selection of eight full scale ranges or remote from 3 to 10,000 or 10 to 30,000 ppm Carbon. The instrument has a 0 to 10 VDC and 4-20 MADC analog (recorder) output signal for each selected range. The ranges may be remote selected externally.

2.2. Product Specifications Model 300 HFID/MHFID

ANALYSIS METHOD: Flame Ionization Detector (FID)

TOTAL RANGES: 0-3, 10, 30, 100, 300, 1,000, 3,000, 10,000, 30,000 ppm Carbon

EIGHT OPERATING RANGES: Switch Selectable from the Front Panel or Remote Range Change.

RESOLUTION: 0.01 ppm Carbon

REPEATABILITY: Better than 0.5% of Full Scale

LINEARITY: Better than 1% of Full Scale to 10,000

Better than 1% of Full Scale above 10,000

O2 EFFECT: Less than 1% of Full Scale

CH4 EFFECT: Less than 1.2 Times Propane

RESPONSE TIME: 90% of Full Scale in 1.5 seconds

SAMPLE FLOW RATE: With Pump 3.0 L/min. ±1.5 L/min.

EXTERNAL SAMPLE FILTER: 40 micron required

INTERNAL SAMPLE FILTER: 0.1 micron Replaceable Filter

NOISE: Less than 0.5% of Full Scale

ZERO & SPAN DRIFT: Less than 1% of Full Scale per 24 hours

ZERO & SPAN ADJUSTMENT: Ten Turn Potentiometer

FLOW CONTROL: Electronic Proportional Pressure Valve

FUEL REQUIREMENTS: 40% H2 60% He 120 cc/min. or 100% H2 at Specified Flow Rate (Model 300HFID Only)

AIR REQUIREMENTS: Less than 1 ppm THC. See Individual Sheet for Specific Flow Rates

DISPLAY: 3½ Digit Panel Meter.

DIAGNOSTICS: 3½ Digit Meter with seven Position Switch

Collector Voltage	+15 VDC
Fuel Pressure	Oven Temperature
Air Pressure	Burner Temperature
Sample Pressure	

ANALOG OUTPUT: 0-10 VDC and 4-20 MADC

FUEL/AIR CONTROL: Forward Pressure Regulator & Capillaries

IGNITION: Momentary Push-Button With Flame-On Indicator (Manual or Remote Control)

FLAME OUT INDICATOR: Automatic Fuel Shut Off

AMBIENT TEMPERATURE: 5 to 45 Degrees C

SAMPLE TEMPERATURE: 0 to 50 Degrees C

WARM-UP TIME: 1 Hour

FITTINGS: 1/4 Inch Tube

POWER REQUIREMENTS: 115/230 (±10%) VAC 50/60 Hz; 600 Watts

DIMENSIONS: 5¼ H × 19 W × 24 D (Inches)

RELATIVE HUMIDITY: Less than 90% RH

WEIGHT: 38 Pounds

Specifications subject to change without notice

2.3. FID OPTIONS

- Methane Cutter (Reads Only Methane in Sample)
- Specify Fuel Type
- 19 Inch Rack Mount Slides
- Remote In-Line Filter

3. INSTALLATION

3.1. General

The design of the instrument is for industrial applications. These installation instructions are for a typical site. Direct any questions regarding specific installation situations to Technical Service of California Analytical Instruments, Inc.

3.2. Site and Mounting

NOTE: Observe the following precautions carefully:

1) Select a site free from direct sunlight, radiation from a high temperature surface, or abrupt temperature variations.
2) This analyzer is not suitable for outdoor installation. If installed outdoors, shelter the instrument from wind and rain
3) Select a site where the air is clean. Avoid exposing the instrument to corrosive or combustible gases.
4) The instrument must not be subject to severe vibration. If severe vibration is present, use isolation mounts.
5) The design of the instrument is for rack mounting. Optional rack mount slides are available.
6) Do not install near equipment emitting electromagnetic interference (EMI).

NOTE: A rear supporting brace or equivalent is required if the optional rack mount slides were not purchased.

3.3. Electrical

Connect all wiring at the rear of the instrument. Table 4-1 on the following page show the connect outputs, etc. Connect the AC power to the power/fuse/switch as shown below in Figure 4-1.

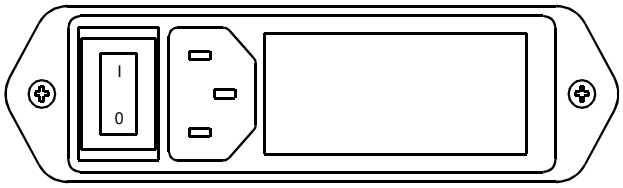


Figure 3-1 AC Power Switch, Connector, and Fuse.

NOTES: A defective ground may affect the operation of the instrument. Connect the output voltages per Table 4-1. Shielded wiring is recommended for output signals.

CAUTION: Electromagnetic interference (EMI) may affect the operation of the instrument. Do not install the instrument near electrical noise (such as high frequency furnaces, electric welding machines, etc.). A separate power line must be used If the instrument must be installed at such locations. Control the noise from a relay or solenoid valve by the use of an EMI suppressor (RC circuit) across the power wiring close to the noise-generating component (see Figure 4-2).

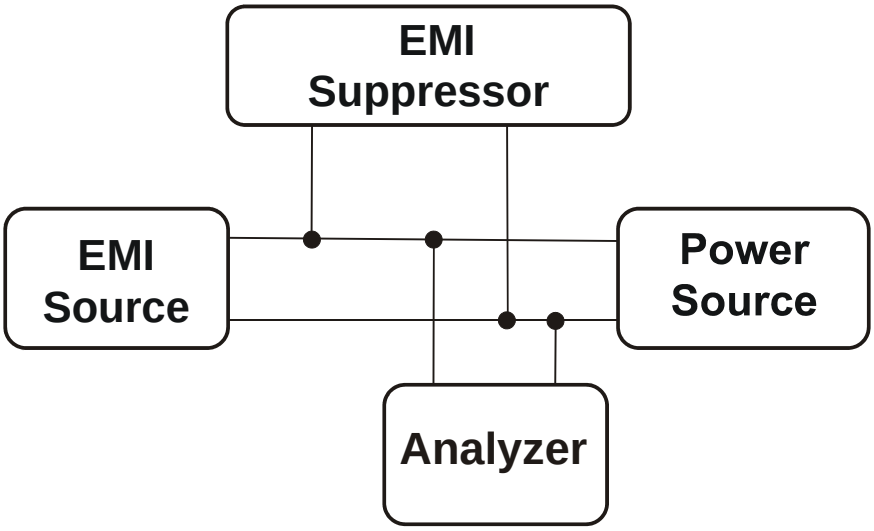


Figure 3-2 EMI Suppressor.

NOTE: Locate the EMI Suppressor close to the noise source.

3.4. Remote Range Operation

Obtain remote range identification and range selection by the rear panel connections. When selecting a range the corresponding control line pulls low to zero VDC. Ranges not selected will remain at approximately 5 VDC.

Selecting remote range control on the front panel switch provides a contact closure at the rear panel connector. Remote range selection and FID ignite is made by connection of the control wire at the rear panel connector. A contact closure at the rear panel connector indicates FID "Flame On."

NOTE: Shielded wiring is recommended for output signals.

3.5. Sampling System

The analyzer's sampling system consists of:

1) An internally mounted in line particulate filter
2) An internally mounted in line particulate filter
3) A sample pump and flow meter (optional)
4) A sample capillary that controls the sample flow rate to the sensor at 0.5 LPM.
5) A precision controlled relief valve.

The relief valve maintains a constant inlet pressure to the sample capillary and reduces response time by providing a bypass loop to the exhaust for excess sample.

The design of the analyzer is to measure a conditioned clean dry sample gas. Removal of the moisture is to prevent condensation in the analyzer. Some applications may require additional sample conditioning, dependent upon the specifications of the measured sample gas.

3.6. Required Gases and Gas Handling Equipment

6) Air (zero and burner air, < 1 ppm C) in pressurized cylinder.
7) Fuel 40% H2/60% He or 100% H2 in pressurized cylinder. (As Specified)
8) Standard span gas(es) near full-scale concentration (typically 80-95% of the analyzers measuring range) with an air balance, in a pressurized, certified cylinder.
9) Pressure regulators for zero and span gas cylinders.
10) Corrosive resistant gas tubing.
11) Flow meter with valve (0-2 LPM) — if not supplied as an analyzer option.
12) Pump— if not supplied as an analyzer option.

3.7. Gas Connections

The tubing from the sampling system to the gas analyzer should be corrosive resistant material such as Teflon ® or stainless steel. Do not use rubber or soft vinyl tubing should not be used even when the gases sampled are non-corrosive, since readings may be inaccurate due to gas absorption into the piping material. To obtain fast response, the tube should be as short as possible. Optimum tube internal diameter is 0.16 inch (4 mm). Instrument couplings are ¼-inch tube. A sample-gas outlet fitting is located on the rear panel (¼-inch tube). Keep pressure at this outlet at atmospheric level. Vent this gas from the instrument.

In general, use heated sample lines for measuring heavy hydrocarbons. This instrument does not control the temperature in the external heated lines. There are provisions to terminate heated sample lines at the rear of the instrument to eliminate “cold” spots.

NOTE: Teflon® is a registered trademark of E. I. du Pont de Nemours and Company.

NOTE: Be sure tubing and joints are clean. Dust entering the instrument may cause it to malfunction.

3.8. Sampling Requirements

1) Filtration

   a) Eliminate all dust. Use filters as necessary.

   b) Remote: A remote heated filter is recommended. A minimum of 40 microns is required.

   c) Internal: The instrument includes an internal 0.1 micron filter located in the heated oven compartment. This fiberglass filter is easily replaceable.

2) Condensation

   - Dew point of the sample gases must be lower than the temperature of the heated sample line to prevent accidental hydrocarbon condensation.

1) Presence of Corrosive Gases

   - High concentrations of corrosive gases such as Cl_2, F_2, HCI, etc. present in the sample gas will shorten the useful service life of the instrument.

2) Gas Temperature

   - The Model 300 HFID/MHFID is factory set at 190º C unless specified at other temperatures.

3.9. Pressure and Flow Rate

An internal pressure regulator controls the burner air entering the instrument. The air cylinder pressure should be set at 30 PSIG. The air regulator is factory set for proper air/fuel ratio as indicated on the QA Check Sheet and as included in this manual.

Fuel	+/- 1.0 PSIG of Indicated Setting
Air	+/- 1.0 PSIG of Indicated Setting
Sample	+/- 1.0 PSIG of Indicated Setting

NOTE: Do not operate the FID sample pump with sample lines that have more than 2 PSIG pressure. If using sample lines to introduce zero/span gases, do not exceed 2 PSIG at sample pump.

A factory set precision electronically controlled proportional flow controller controls the sample and fuel entering the instrument.

For proper flow control, set the sample gas and fuel entering the instrument at a pressure between 6 and 25 PSIG at a flow rate of 4 ± 1.5 liters/min.

If ordered, the internal heated sample pump automatically maintains this pressure. The calibration/span and zero-gas-cylinder-pressures should be set at 30 PSIG.

3.10. Sample Gas By-Pass Outlet (Vent)

A sample-gas by-pass outlet-connector is located on the rear panel (¼ Inch Tube). Keep pressure at this outlet at atmospheric level. ANY backpressure may cause an error in reading. Vent this gas away from the instrument.

4. DESCRIPTION AND FUNCTION COMPONENTS

4.1. Model 300 HFID/MHFID Analyzer Front Panel

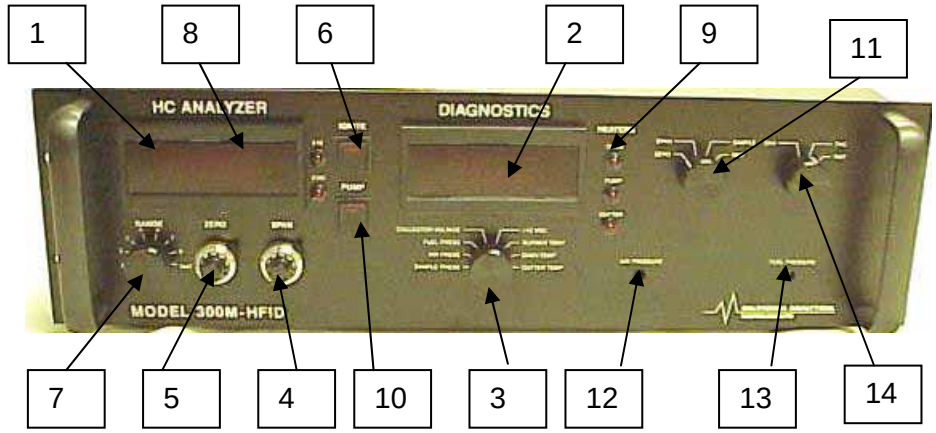


Figure 4-1 Model 300 HFID/MHFID Analyzer Front Panel with CH_4 Cutter

1) Digital Indicator (3 1/2 Digits): Displays analyzer output.
2) Digital Indicator (3 1/2 Digits): Displays diagnostic functions.
3) Diagnostic Switch: Eight Position Switch Displays:

Collector Voltage (DCV)	Plus 15 VDC Supply
Fuel Pressure (PSIG)	Cutter Temperature (C)
Air Pressure (PSIG)	Burner Temperature (C)
Sample Pressure (PSIG)	Oven Temperature (C)

4) Span Control: Sets fine gain of instrument. (Adjust while span gas is flowing through instrument.)
5) Zero Control: Sets zero level of instrument. (Adjust while zero gas is flowing through instrument.)
6) Ignite Switch: Depressing the momentary push-button ignite switch starts the burner ignites sequence. The illuminated LED in the switch and a contact closure on the rear panel connector indicates Burner ON condition. Remote ignite may be accomplished via a contact closure on the rear panel connector.
7) Range Switch: Allows selection of ranges 1 through 8 or remote. The remote position allows for remote computer control of ranges via a contact closure on the rear panel connector. An internal slide switch selects ranges 3 to 10,000 or 10 to 30,000 ppm C.
8) Multiplier LED's: Meter Reading Times 10 or 100.
9) Heated Cycle Switch: Indicates Pump, Oven, and Cutter Heaters are cycling.
10) Pump Switch: Turns On Heated Internal Sample Pump
11) Sample/Zero/Span/Remote Switch: Activates Internal Solenoids.
12) Air Pressure Adjust: Adjusts Air Pressure (See Factory Settings Sheet).
13) Fuel Pressure Adjust: Adjusts Fuel Pressure (See Factory Settings Sheet).
14) Methane Cutter Switch: Turns On Methane Cutter.

4.2. Model 300 HFID/MHFID Analyzer Rear Panel

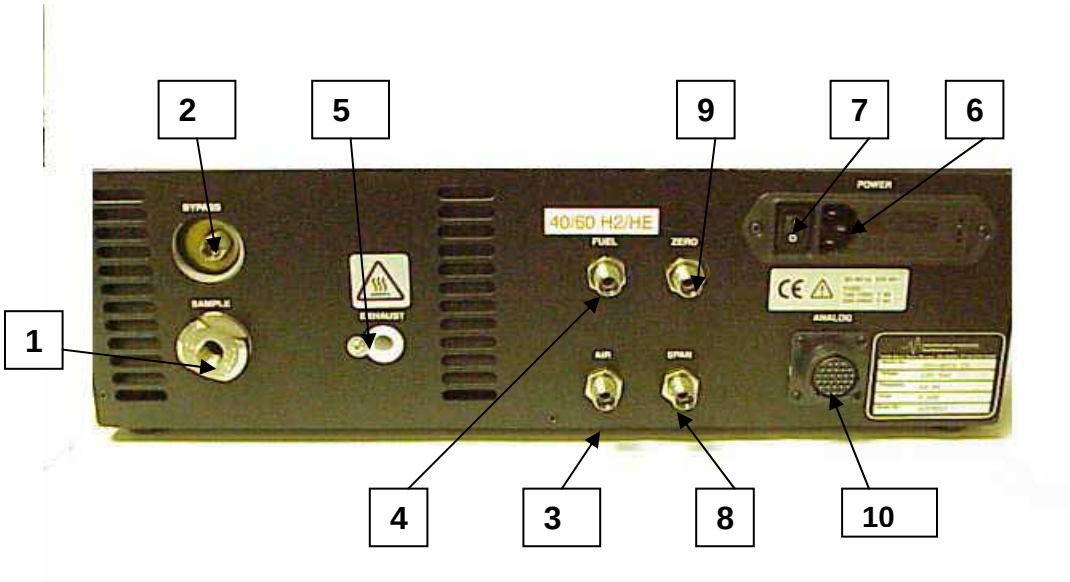


Figure 4-2 Model 300 HFID/MHFID Analyzer Rear Panel

1) **Sample Gas Inlet:** Feeds sample gas to the analyzer. Threaded ¼ Inch Tube. Fitting also contains a heated filter.
2) **Sample Gas By-Pass Outlet (Vent):** Exhaust for sample. Threaded ¼ Inch Tube.
3) **Burner Air Inlet:** For feeding hydrocarbon free air to the burner. See Figure 8. Threaded ¼ Inch Tube.
4) **Fuel Inlet:** For feeding fuel to the burner. See Figure 8. Threaded ¼ Inch Tube.
5) **Burner Outlet (Vent):** Exhaust for burner (No fitting required)
6) **Power Entry Module:** Power cord connection, power switch, fuse compartment.
7) **Rear Panel Power ON/OFF Switch:** Turns ON/OFF line power to instrument.
8) **Span Gas Inlet:** Inputs Span Gas to Optional Solenoids
9) **Zero Gas Inlet:** Inputs Zero Gas to Optional Solenoids

Table 4-1 Connector for External Wiring

1. V Out Common	9. Zero Select	17. R1 ID/Control	25. Remote Range Control
2.	10. Span Select	18. R2 ID/Control	26. Remote Range Common
3. 0- 10 VDC	11. Flame On Output	19. R3 ID/Control	27. 5 VDC
4. I Out Common	12. Flame On Common	20. R4 ID/Control	28. DC Common
5. I Out (4-20 MADC)	13. Ignite On	21. R5 ID/Control	
6. THC/CH4 Common	14. Ignite Common	22. R6 ID/Control	
7. Select THC or CH4	15. Sample Select	23. R7 ID/Control	
8. Oven Temp	16. Z/S/Sample Common	24. R8 ID/Control	

Table 4-2 Twenty Eight Conductor Cable Color Chart

Pin Number	Wire Color	Wire Color Abbreviation
1	DARK BROWN	DK BR
2	RED	RD
3	ORANGE	OR
4	YELLOW	YL
5	GREEN	GR
6	LIGHT BLUE	LT BL
7	VIOLET	VI
8	GRAY	GY
9	WHITE	WH
10	BLACK	BK
11	LIGHT BROWN	LT BR
12	PINK	PN
13	BLUE	BL
14	LIGHT GREEN	LT GR
15	WHITE/BLACK	WH/BK
16	WHITE/RED	WH/RD
17	WHITE/GREEN	WH/GN
18	WHITE/YELLOW	WHNL
19	WHITE/BLUE	WH/BL
20	WHITE/BROWN	WH/BR
21	WHITE/ORANGE	WH/OR
22	WHITE/GRAY	WH/GR
23	WHITE/VIOLET	WH/I
24	WHITE/PINK	WH/PN
25	WHITE/LIGHT GRAY	WH/LT GY
26	BLACK/RED	BK/RD
27	BLACK/ORANGE	BK/OR
28	BLACK/BROWN	BK/BR

5. Major Internal Components

5.1. Model 300 HFID/MHFID Interior Layout

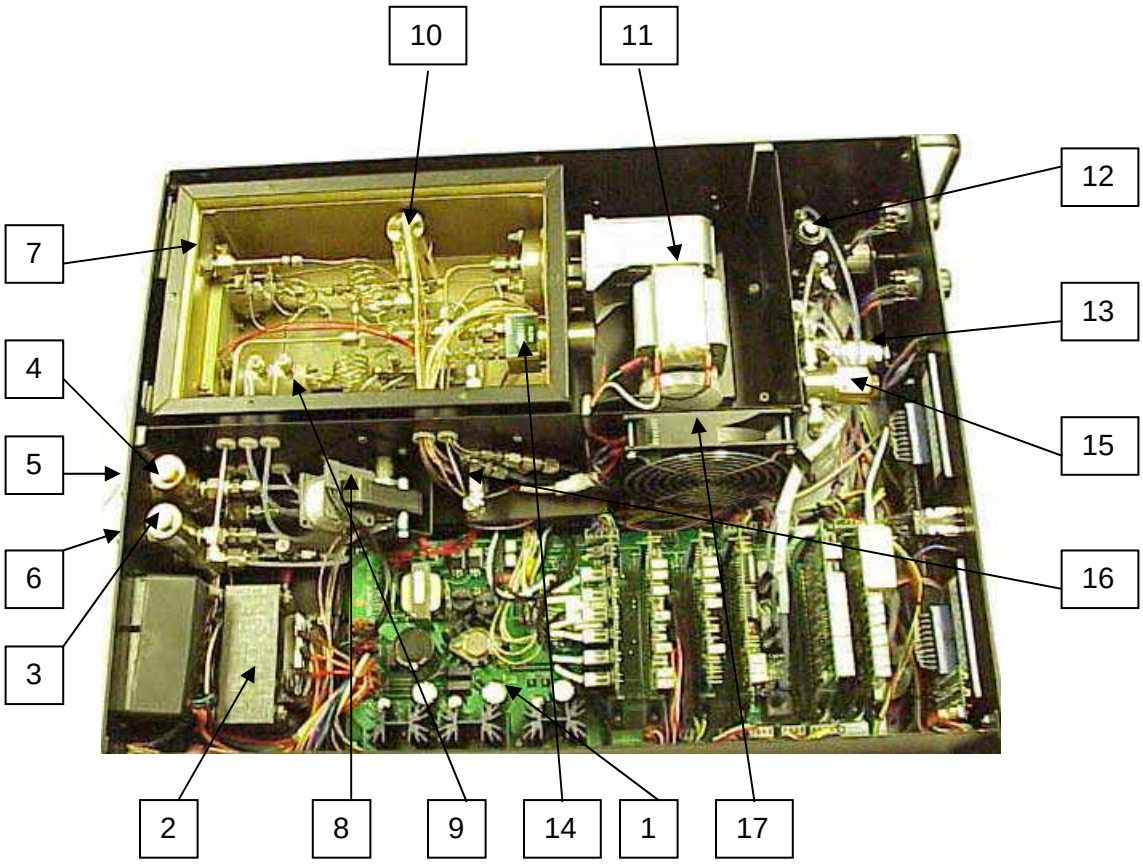


Figure 5-1 Model 300 HFID/MHFID Interior Layout

1) **Mother Board:** Includes components for all power supplies and connector for the individual plug in boards. See Figure 6 for board locations.
2) **Power Transformer:** Converts line voltage to several lower AC voltages and delivered to the main circuit board.
3) **Zero Solenoid Valve:** Allows Zero Calibration Gas To Flow to Burner.
4) **Fuel Solenoid Valve:** Automatic Fuel Shut Off.
5) **Air Solenoid Valve:** Automatic Air Shut Off.
6) **Span Solenoid Valve:** Allows Span Calibration Gas To Flow to Burner.
7) **Heated Oven:** Maintains Sample Components at Set Temperature (Cover Removed).
8) **Oven Circulation Fan Motor:** Maintains constant oven temperature.
9) **Burner Assembly**: FID Burner.

10) **Methane Cutter:** Removes ALL THC, except Methane.

11) **Heated Sample Pump/Motor:** Provides sample to Burner Assembly.

12) **Fuel Proportional Control Valve:** Regulates Pressure to Fuel Orifice.

13) **Air Pressure Regulator:** Regulates Pressure to Air Orifice.

14) **:Sample Proportional Control Valve:** Regulates Sample Pressure to Burner.

15) **Fuel Bleed Valve to Cutter:** Adds Fuel to Cutter.

16) **THC/Methane Solenoid Valve:** Switches between THC and CH4.

17) **Instrument Circulation Fan:** Provides Internal Air Circulation.

5.2. MAIN CIRCUIT BOARD

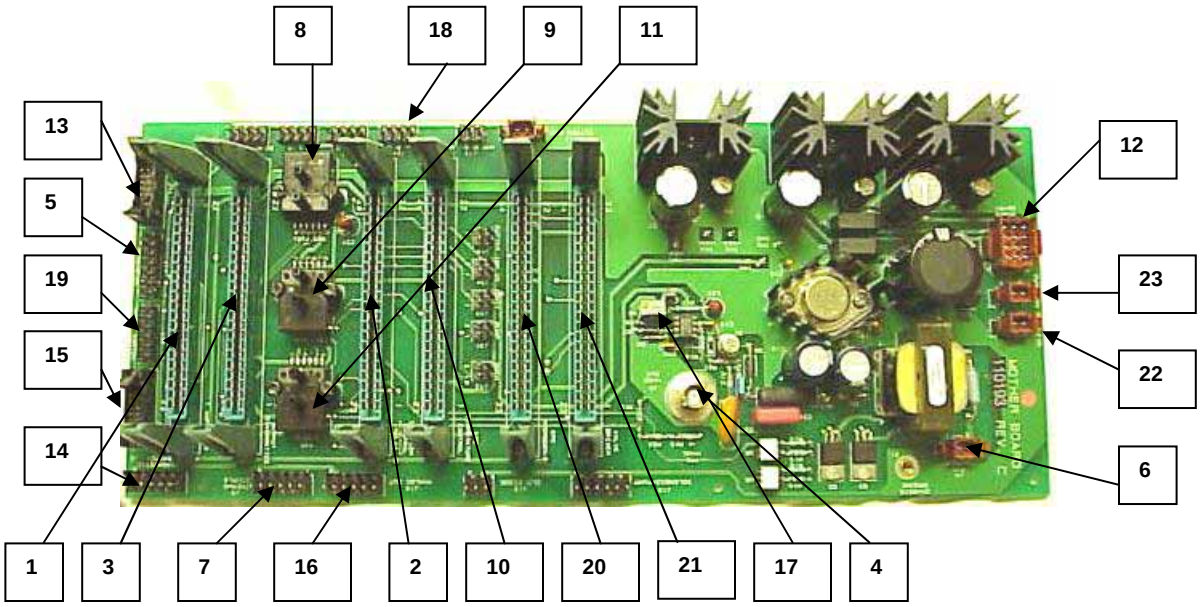
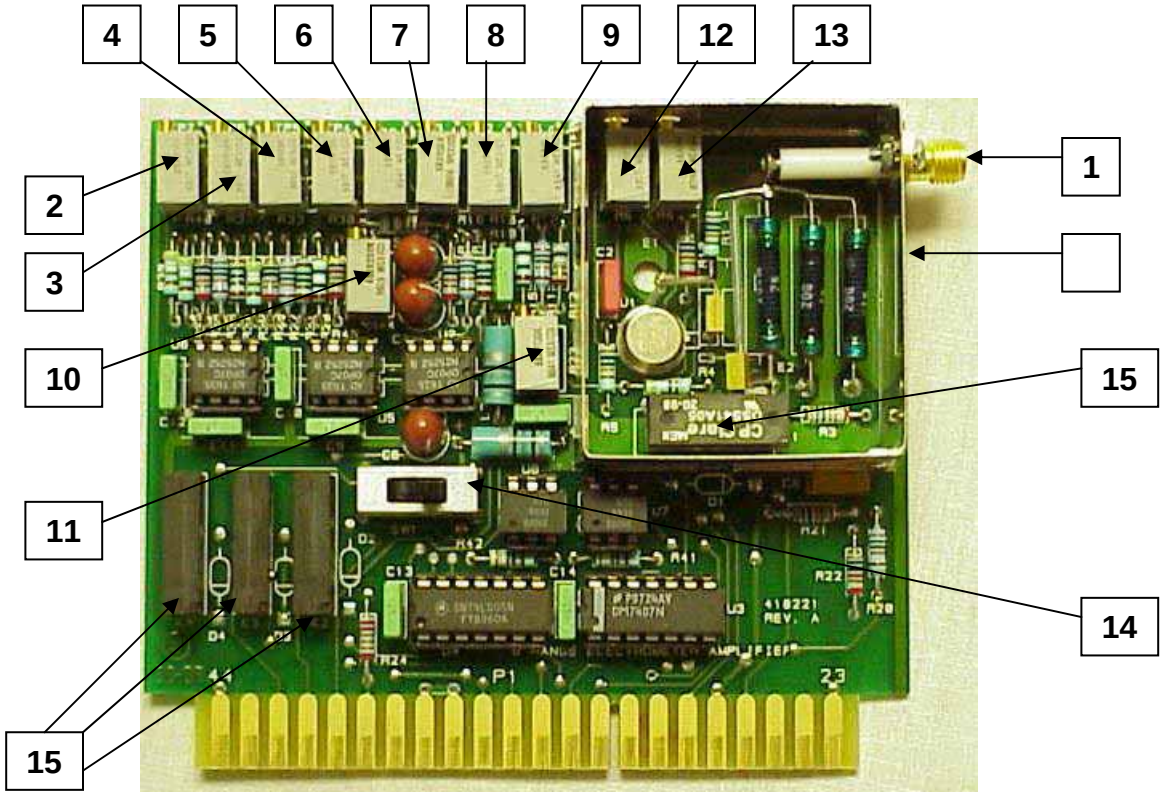


Figure 5-2 Model 300 HFID/MHFID Main Circuit Board

1. Amplifier Board Location: J12
2. Ignite Board Location: J16
3. Diagnostic Board Location: J7
4. Collector Voltage Connection: J5
5. Zero & Span Pot Connection: J14
6. Burner, Igniter Connection: J4
7. Burner, Oven & Cutter TC's: J9
8. Fuel Pressure Connection: SW3
9. Air Pressure Connection: SW4
10. EPC/Temp Control Board: J21
11. Sample Pressure Connection: SW2
12. Transformer Connection: J1
13. Diagnostic Meter Connection: J11
14. Diagnostic Switch Connection: J8
15. Analog Meter Connection: J15
16. Analog Output Connection: J10
17. Collector Voltage Potentiometer: R8
18. Proportional Valve Connection: J24
19. Range Switch Connection: J36
20. H2 & Cutter & Temp Board Location: J23
21. Valve Driver Control Board: J25
22. Oven Circulating Fan Location: P1
23. Pump Fan Location: P2

5.3. MAIN AMPLIFIER BOARD



NOTE: Cover removed from high impedance section.

Figure 5-3 Model 300 HFID/MHFID Amplifier Board

1. Input Connection: SMA Connector
2. Amplifier Gain Adjust: R40
3. Amplifier Zero Adjust: R37
4. Gain Signal Attenuator Adjust: R33
5. Amplifier Zero Adjust: R30
6. Signal Attenuator Adjust: R26
7. Coarse Gain Adjust: R18
8. Amplifier Zero Adjust: R16
9. Signal Attenuator Adjust: R13
10. Filter Time Constant Adjust: R44
11. Coarse Zero Adjust: R23
12. Amplifier Zero Adjust: R6
13. Amplifier Gain Change Adjust: R9
14. PPM/% Switch: SW1
15. Range Change Relays: K1-K4

5.4. Burner Assembly

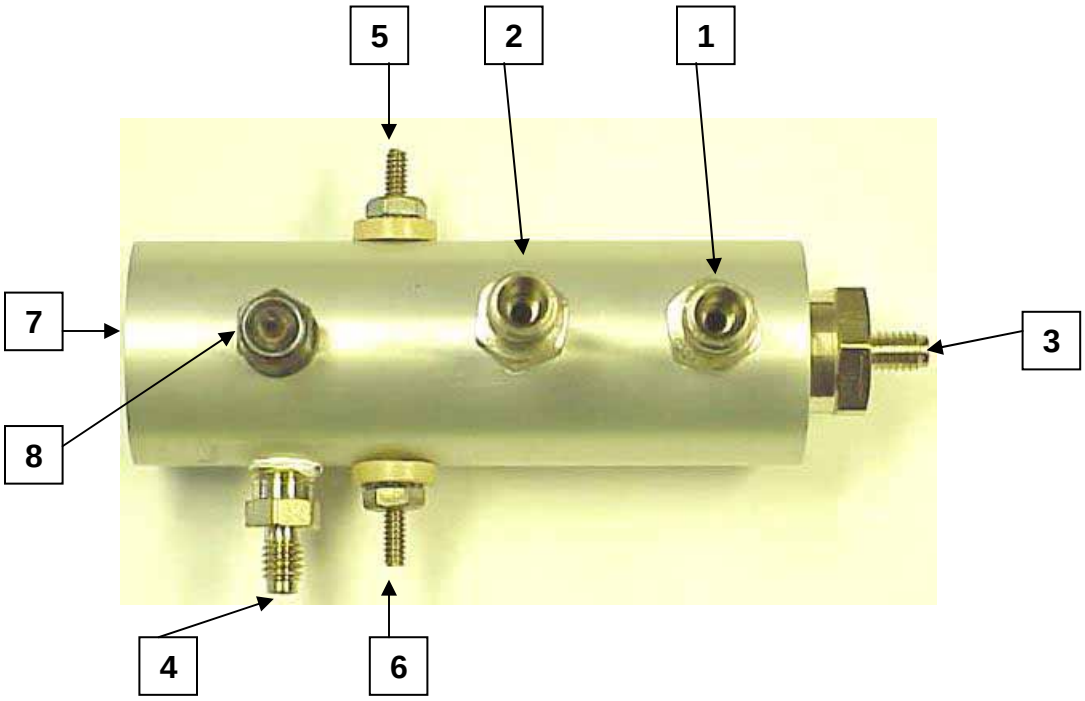


Figure 5-4 Model 300 HFID/MHFID Burner Assembly

1. Fuel Inlet
1. Air Inlet
2. Sample Inlet
4. Thermocouple Connection
5. Collector Voltage Connection
6. Burner Output Signal Connection
7. Burner Exhaust
8. Glow Plug

5.5. Automatic Ignite Board

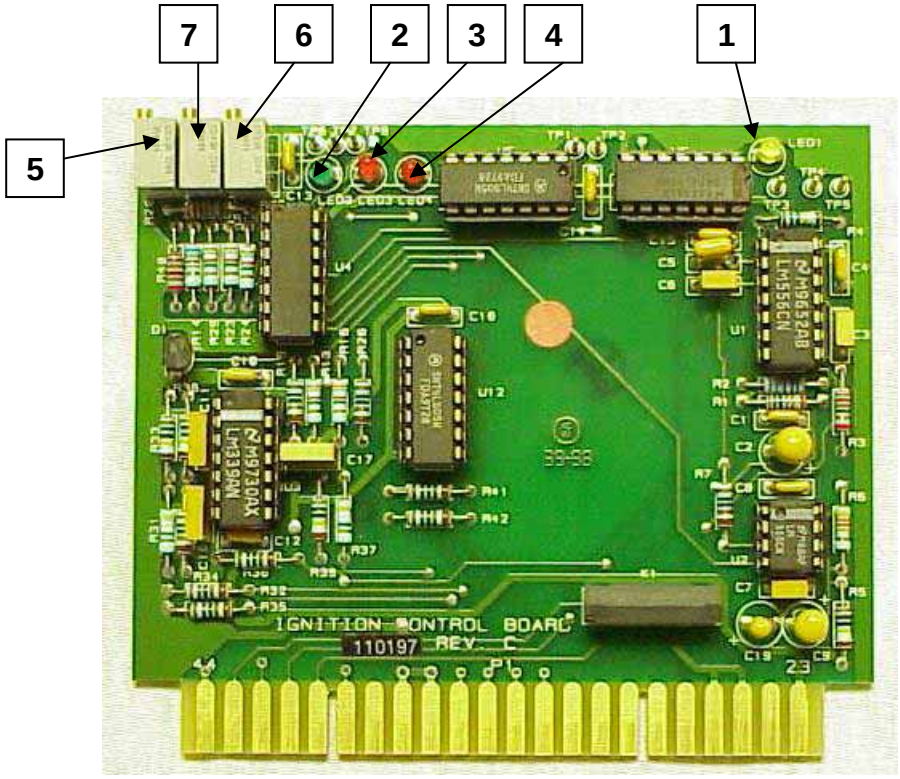


Figure 5-5 Model 300 HFID/MHFID Automatic Ignite Board

1. Glow Plug: LED 1
2. Air Solenoid ON: LED 2
3. Fuel Solenoid ON: LED 3
4. Ignite ON (Burner TC): LED 4
5. Fuel Low Pressure Limit Adjust Pot: R20
6. Air Low Pressure Limit Adjust Pot: R22
7. Burner Flame Temp Limit Adjust Pot: R21

5.6. Diagnostic Board

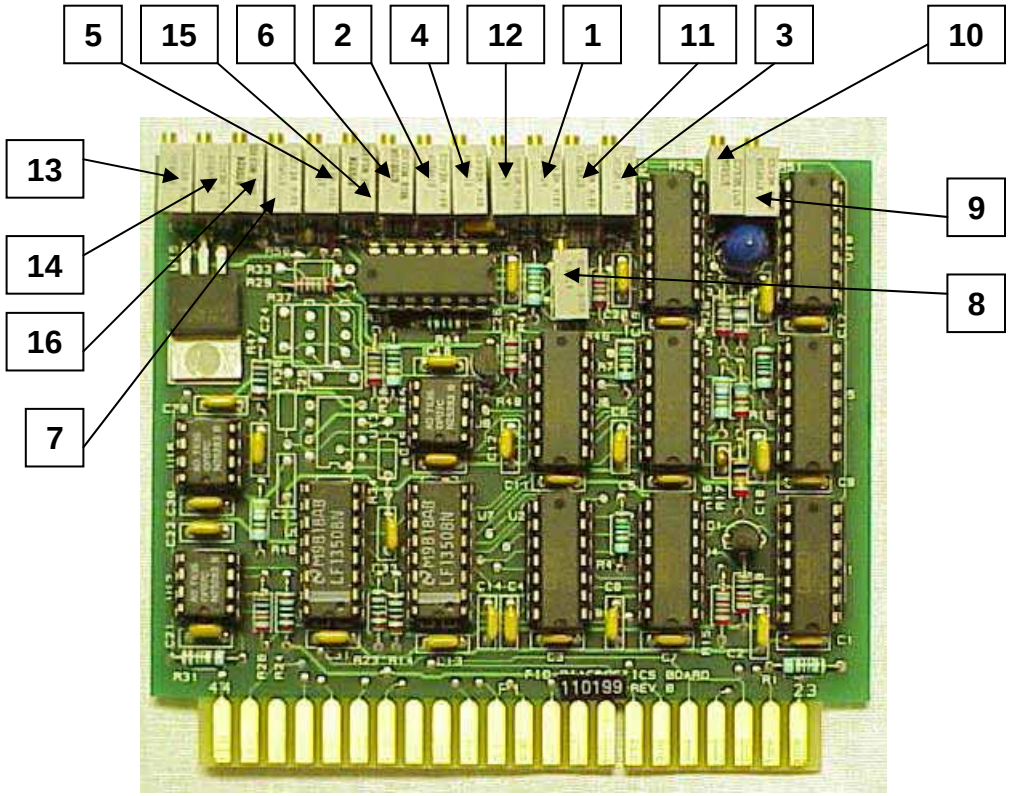


Figure 5-6 Model 300 HFID/MHFID Output Diagnostic Circuit Board

1. Fuel Pressure Zero Pot: R9
2. Fuel Pressure Span Pot: R8
3. Air Pressure Zero Pot: R3
4. Air Pressure Span Pot: R2
5. Sample Pressure Zero Pot: R6
6. Sample Pressure Span Pot: R5
7. Cutter TC Zero Pot: R49
8. Cutter TC Span Pot: R53
9. Burner TC Zero Pot: R51
10. Burner TC Span Pot: R22
11. Oven TC Zero Pot: R27
12. Oven TC Span Pot: R26
13. Analog Voltage Output Zero Pot: R32
14. Analog Voltage Output Span Pot: R30
15. Analog Current Output Zero Pot: R39
16. Analog Current Output Span Pot: R43

5.7. EPC and Dual Temperature Control Board

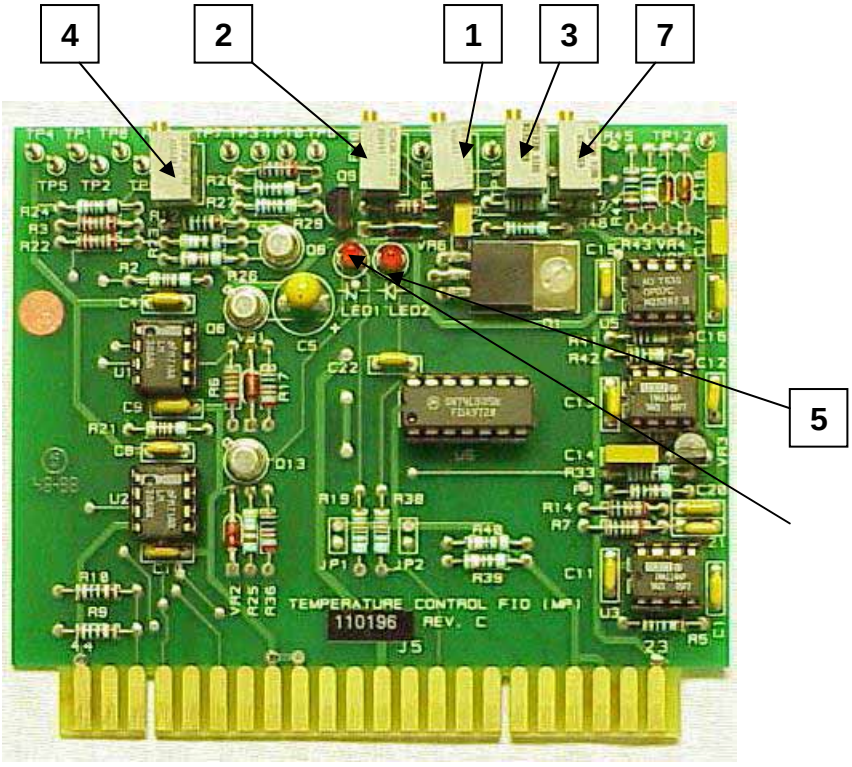


Figure 5-7 Model 300 HFID/MHFID EPC and Dual Temperature Control Board

1.	Sample Pressure Cal Pot: R4	5.	Oven Heater Indicator: LED2
2.	Sample Pressure Adjust Pot: R30	6.	Pump Heater Indicator: LED1
3.	Sample Pressure Gain Pot: R11	7	Amplifier Zero Offset Adjust: R45
4.	Oven & Pump Temp Adjust: R20		

5.8. EPC Hydrogen and Ch4 Cutter Control Board Components

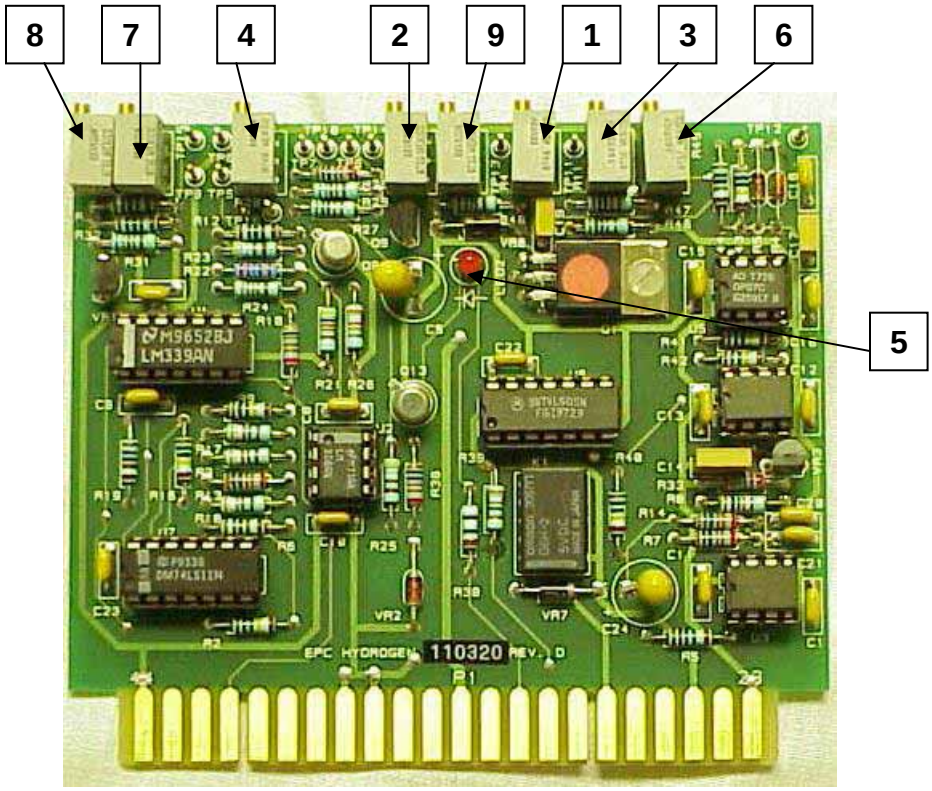


Figure 5-8 Model 300 HFID/MHFID EPC Hydrogen and CH4 Cutter Control Circuit Board

1. Hydrogen Pressure Cal Pot: R4
2. Hydrogen Pressure Ignition Pot: R15
3. Hydrogen Pressure Gain Pot: R11
4. Cutter Temp Adjust: R20
5. Cutter Heater Indicator: LED2
6. Amplifier Offset Adjust: R45
7. Cutter H2 Low Temp Adjust: R34
8. Cutter H2 Low Pressure Adjust: R37
9. Not Used

NOTE: Control the final hydrogen pressure after ignition by the front panel potentiometer.

5.9. Valve Driver Board

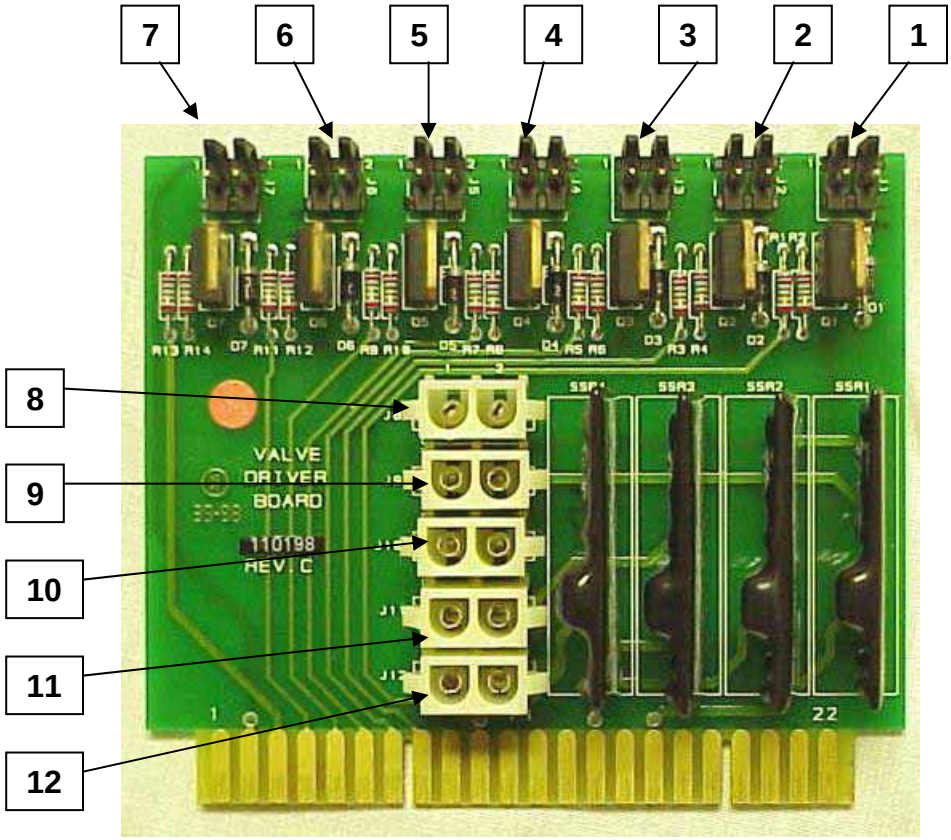


Figure 5-9 Model 300 Valve Driver Board

1. Fuel Solenoid Connection: J1
2. Burner Air Solenoid Connection: J2
3. Zero Air Solenoid Connection: J3
4. Span Gas Solenoid Connection: J4
5. THC/CH4 Solenoid Connection: J5
6. Cutter H2 Solenoid Connection: J6
7. Spare: J7
8. AC Power Connection: J8
9. Pump Heater Connection: J9
10. Oven Heater Connection: J10
11. Cutter Heater Connection: J11
12. Pump On/Off Control: J12

6. Operation

1) Check that the external plumbing and wiring are connected correctly, as described in Section III of this manual.

2) Power On: Turn ON the power switch on the rear panel. The digital panel meters should illuminate. The sample pump and burner should remain off until the oven reaches at least 100 degrees C.

3) Introduce Fuel & Burner Air: Adjust the cylinder output pressures to 30 PSIG. Upon initial installation, loosen the fuel inlet connection to allow the air to bleed from the fuel line. This should only take 5 to 10 seconds. Firmly re-connect the fuel line.

4) Ignition (After Oven at 100 Degrees C): Press the momentary ignite button. This will initiate the automatic ignite sequence.

   a) An electronic proportional control valve that opens and flows fuel at an initial, factory set, high flow rate, controls the fuel pressure. This creates a very rich fuel mixture that saturates the burner with fuel.

   b) After 3 seconds of fuel, the burner air solenoid opens and the ignite glow plug is energized. This cycle repeats for five sequences OR until the burner lights as indicated when the thermocouple reaches a factory set temperature to indicate ignition.

   c) After detecting ignition, the burner ON light in the momentary push button is illuminated and a contact closure is completed on the rear connector. Reduce the burner fuel flow to maintain a more efficient flame. This sequence can be started by a remote (Computer) contact closure.

   d) The sequence will not succeed if the ignition control board senses insufficient fuel or air pressure. The fuel valve and air solenoid will shut off if the burner thermocouple senses a flame out OR lack of either fuel or air pressure.

   e) To meet the drift and repeatability specifications, allow the instrument to warm up for approximately one hour. It is preferable, but not essential, that zero airflow through the instrument during warm-up.

5) Fuel and Air Pressure Settings:

   a) Observe the fuel and air pressure pressures by placing the diagnostic switch in the respective positions.

   b) They should agree with the factory set pressure settings indicated on the QA Checkout Sheet, +/- 1.0 PSIG.

   c) If necessary, reset the air and fuel pressures by adjusting the front panel potentiometers or regulator.

6) Flame Optimization: The fuel and air flow-rates are controlled using state-of-the-art pressure control and internal critical flow capillaries. This maintains flame optimization if the fuel and air pressures are within +/- 1.0 PSIG of the respective settings, indicated above.

7) Zero Adjustment:

   a) After the one-hour warm-up period, flow zero gas through the instrument sample or zero inlet.

   b) Adjust the zero control on the front panel until the digital panel meter or recorder reading reads exactly zero.

8) Span Adjustment:

   a) Flow span gas through the instrument sample or span inlet.

   b) Adjust the span control on the front panel until the digital panel meter, or recorder, reading is at the value specified for the span gas concentration.

9) Sample Pressure Check:

   a) With sample or span gas flowing through the instrument, place the diagnostic switch in sample position.

   b) The inlet sample pressure must be above 6 PSIG for the meter to read original factory setting (+/- 1.0) PSIG, unless the instrument has an internal sample pump, then pressure is automatically controlled. (See Factory Settings Sheet)

10) Methane ONLY Operation: Switch the CH4 cutter in and out of the sample stream to measure total hydrocarbons or methane only.

6.1. Start-Up Procedure

1) Sampling System: Prepare and check the sample system.
   a) Check the sample pressure and by-pass flow and verify agreement with the factory QA Checkout sheet, (+/- 1.0 PSIG).
   b) Failure to meet the sample pressure may be due to a dirty filter. See Page 29 for replacement procedure.
2) Air & Fuel Pressure:
   a) Check the fuel and air pressures for agreement with the factory QA Checkout sheet, (+/- 1.0 PSIG).
   b) Readjust pressures as required.
   c) Note: Cylinder pressures should be set at 30 PSIG.
3) Zero & Span Calibration:
   a) Check zero and span adjustment daily.
   b) While flowing zero gas check the zero reading and readjust, if necessary, using the front panel zero control.
   c) While flowing span gas check the span reading and readjust, if necessary, using the front panel span control.

6.2. Shutdown Procedure

1) Turn off all gas supply cylinders.
2) Disconnect the sample line from the inlet port on the back of the analyzer.

Do NOT turn off the pump or analyzer at this time.

3) Allow the analyzer to draw in room air for approximately 5 minutes. This will flush out the analyzer of any remaining sample that may condense in the sample system.
4) Turn off the pump switch and THEN the analyzer.
5) Back-flush the heated sample line (and filter) of any sample before disconnecting power.

7. FUNCTIONAL DESCRIPTION

7.1. Operating Principle

The California Analytical Model 300 HFID Heated Total Hydrocarbon Analyzer uses the flame ionization detection-method of determination of total carbon (C) in a sample gas.

The detector is a burner in which a regulated flow of sample gas passes through a flame sustained by a regulated flow of hydrocarbon free air and fuel gas 40% H_2/60% He or 100% H_2, as specified. Within the flame, the hydrocarbon components of the sample undergo an ionization process that produces electrons and positive ions. A 250 volt (-250 VDC) polarized electrode ring collects these ions, causing a very low current to flow. A precision amplifier amplifies this low current. This current flow is directly proportional to the carbon content of the sample.

The instrument includes a temperature controlled sample oven. The oven maintains the sample at an elevated temperature. This temperature is adjustable from ambient to 200 ºC.

7.2. Burner Assembly

Unique regulated flow systems deliver the sample, burner air and fuel to the burner via the described below. The sample and fuel mix and pass through the burner tip. Added air maintains the proper air/fuel mixture to sustain ignition. Energizing a standard glow plug accomplishes Ignition. The dual ring electrode functions as electrodes and are connected to a precision high voltage regulated 250 volt DC power supply and the precision amplifier. The small ionization current flowing between electrodes is directly proportional to the carbon atoms in the sample stream.

7.3. Methane Cutter (Non-Methane Hydrocarbons)

The cutter utilizes a temperature controlled metal oxide catalyst to oxidize all hydrocarbons in the sample except methane. The cutter catalyst assembly uses a cartridge heater and an RTD with electronic proportional circuitry to maintain the catalyst converter at the factory value of approximately 280ºC. The operator can first elect to measure the total hydrocarbons in the sample by bypassing the cutter. Switch the cutter in and out of the sample stream with the front panel switch or remotely via a contact closure. Switch the cutter into the sample stream to read only the methane content of the sample. Simple subtraction will yield the non-methane hydrocarbon content of the sample.

7.4. Flow System

The basic function is to deliver highly regulated flows of sample, fuel, and air to the burner assembly. The air pressure regulator delivers the appropriate pressure to critical flow capillary. The control of the fuel is via a precision, electronically controlled proportional flow controller through a critical capillary. This control accurately pre-determines the flame characteristics without the need of flame optimization adjustments. The supply cylinders should be set to 30 PSIG.

The sample flow to the burner is via a precision, electronically controlled proportional flow controller through a critical capillary. This pressure is factory set at approximately 2 PSIG. A close-coupled by-pass capillary minimizes "dead volume" and improves response time. This by-pass flow is factory set by the capillary and flows approximately 3 liters/Min. Internal pressure transducers monitor sample inlet pressure, regulated fuel and air pressures. The values are available via the diagnostics meter.

8. ELECTRONICS

8.1. Main Circuit Board

The main circuit board contains the instrument power supplies and edge connectors for the required control boards. A single transformer is used to allow operation form 110/220 VAC at 50/60 Hz. Change a small circuit board from the back panel of the instrument to convert from 110 to 220 VAC.

This main board also contains the plug-in connectors for all the additional electronic circuitry in the instrument, providing ease of maintenance. The board also contains clearly marked test points for diagnostic purposes, including +15, -15, + 24 and –250 VDC, + 5, etc.

8.2. Main Amplifier Board

The main amplifier board contains the low noise low trans-impedance amplifier used to amplify the ionization current produced in the burner. The amplifier changes the current to a representative voltage and scales the output. This board contains a coarse zero and span potentiometers that work in conjunction with the front panel controls. This amplifier also contains the nine range electronic components, which sets the instrument's eight operating ranges.

8.3. Automatic Ignite Board

The automatic ignite circuit board contains the logic circuitry required to perform an automatic ignite function. The front panel momentary ignite switch is used to begin the ignite sequence. LED's on the board give visual indication of the operation of the air solenoid, fuel solenoid, and glow plug.

8.4. Diagnostic Board

The diagnostic circuit board contains the logic circuitry required to convert the instrument transducers output signals for presentation via a 7-position switch to the diagnostic digital panel meter.

8.5. EPC/Dual Temperature Control Board

This board, when fully populated, contains the circuitry required to temperature control the oven, pump temperature, and contains the logic circuitry required for precision control of the sample proportional flow controller.

A single potentiometer controls the temperature of both the pump and oven. A pressure transducer measures the sample pressure directly at the entrance of the burner capillary. The electronically controlled proportional control valve automatically adjusts to maintain this pressure at the factory setting.

8.6. EPC Hydrogen/Cutter Temperature Control Board

This board, when fully populated, contains the circuitry required to temperature control the THC cutter, control the hydrogen solenoid, and provide pressure control for the hydrogen electronic control valve. To assure proper cutter operation, a small amount of burner fuel is introduced to the cutter and the solenoid is activated only when proper temperature and pressures are satisfied. As with the EPC/Dual Temperature Control Board, an EPC valve is used to accurately control the burner fuel pressure. During the ignition process, the fuel pressure is increased to facilitate ignition. After ignition, this pressure is reduced to factory setting to optimize the burner.

8.7. Valve Driver Control Board

This board, when fully populated, contains the seven amplifiers and four solid state relays necessary to electrically control the instrument solenoid valves and AC devices. EXTREME CAUTION should be taken, as instrument supply voltages are located on both sides of this board. Either 120 or 220 VAC.

9. GENERAL INFORMATION-TROUBLESHOOTING-DISASSEMBLY PROCEDURES

9.1. Oven Burner Assembly Filter Unit/Filter Removal

1) Shut off ALL gas flow. **CAUTION:** Burner may be hot if recently operational.
2) Remove power from the instrument.
3) Remove the sample line.
4) When the filter has cooled, use one wrench to hold the filter body and a second wrench to remove the filter holder assembly.
5) Remove and replace the filter. Re-install.

9.2. Electronic Boards/Removal

1) Shut off ALL gas flow.
2) Remove power from the instrument.
3) Remove the top cover retaining screws.
4) Slowly remove the individual plug-in circuit boards.

9.3. Electronics

For ease of service, ALL electrical connections terminate on the main circuit board using plug-in connectors. The following information may be of use to the electronic technician:

1) The digital panel meters are powered by 5 VDC from the main circuit board. If the instrument seems to operate properly, output analog voltage, etc., except the meter display, refer to the main circuit board schematic and check the 5 volt section, 3 terminal regulators, capacitors, etc.
2) The +/- 15 VDC supplies from the main circuit board must be operating properly. If any of these are not operational, refer to the main circuit board schematic and check the 15 volt section, 3 terminal rectifiers, capacitors, etc.
3) The -250 VDC burner collector voltage supply from the main circuit board is operating properly as indicated by the diagnostic meter. If this voltage is not between -200 and -300 VDC, refer to the main circuit board schematic and check the HVDC section, 3 terminal regulators, capacitors, transistors, op amps, etc.
4) The 4 VAC burner glow plug voltage supply from the main circuit board is operating properly as indicated by the sequencing LED on the ignite board, during the ignite cycle. If this LED not illuminating, refer to the main circuit board schematic and check the 4 VAC section, transformer, etc.

9.4. Flow System/Fuel and Burner Air Supply.

Capillary protection micro-screen metal filters are contained in the respective solenoid output fittings. If difficulty occurs during the lighting sequence, **TEMPORARILY** remove these filters when proceeding with diagnostic activity. It is necessary to replace contaminated filters.

These flows are controlled by adjustable forward pressure devices that require 30 PSIG cylinder supply pressure and are factory set at the pressures indicated on the QA Check Sheet +/- 1.0 PSIG. These pressures may be monitored by the diagnostics meter during the ignite sequence or after the flame is ignited. The burner flow rate from the orifices is very low and will require a bubble flow meter to determine proper flow rates. If the pressures are properly set, if clogged lines are suspected replace the delivery lines containing the orifices.

NOTE: Depending upon the amount of moisture contained in the sample gas, problems may develop in re-igniting the burner. If this should occur, perform the following procedure:

1) Remove the Teflon sleeve from the burner exhaust on the rear panel.
2) Through a Teflon line, direct a flow of clean DRY gas into the burner exhaust port. A good source to utilize would be the instrument burner air supply. Reduce the pressure on this air supply and direct the clean air into the rear of the burner from approximately 2-4 inches. Let this air flow for approximately 1 minute. DO NOT insert this line directly into the burner.
3) Restore all gas lines and, with the Teflon sleeve removed, attempt to light the burner.
4) If the burner will still not light, contact the factory.

9.5. Sample Supply

An inline SMALL filter is contained in the heated oven, however an external sample orifice protection sintered metal filter is highly recommended for trouble-free operation.

An optional remote in-line filter assembly is available from CAI. If difficulty occurs with erratic sample flow, **TEMPORARILY** remove this filter when proceeding with diagnostic activity. It is necessary to replace contaminated filters.

An adjustable electronic proportional pressure valve controls the sample flow. This pressure may be monitored by the diagnostics meter at any time. The instrument has an internal sample pump and is factory set per the QA Check Sheet.

10. TROUBLESHOOTING GUIDE

SYMPTOM	CAUSE	REMEDY
Downscale indication with flame out.	Electrical leakage in burner.	Check Burner voltage.
Burner will not ignite.	Air and/or Fuel Pressures improperly adjusted. Improper operation of glow plug.	Depress Ignite button, and with diagnostic switch verify all pressures per manual. Adjust regulators as required. **(IF OK)** Depress Ignite button, and from rear of instrument, check for red glow from plug at burner vent. **(IF OK)** If plug glows, bleed off fuel line to instrument for 5 seconds. **(IF OK)** Check glow plug connections. **(IF OK)** Check for 3 VAC at plug connections. If OK, replace plug. **(IF OK)** View ignite board LED's for proper sequence. Replace board if necessary. **(IF OK)** Check for 4 VAC at plug connections. If no voltage, replace transformer. **(IF OK)** Check switch continuity. Replace if necessary. **(IF OK)** Replace fuel and/or air critical orifices.
Noisy Signal.	Sample pressure under regulator control limit of 6 PSIG. Water or contamination in burner.	Check and adjust as required. Change fuel and/or air supply. Replace external tubing. Check burner voltage.
Loss of Sensitivity. (Not enough gain)	Contamination in fuel/air or sample flow system.	Verify air & fuel pressures to be set per calibration sheet. **(IF OK)** Verify sample pressure to be set per calibration sheet. **(IF OK)** Verify by-pass flow to be at 3 Liters/Min. +/- 1.5. **(IF OK)** Verify 250 volt DC collector voltage. (+/- 15 Volts) **(IF OK)** Carefully remove burner signal co-ax cable. Touch center conductor and watch for up scale reading. **(IF OK)** Remove and clean sample critical orifice. **(IF OK)** Check Co-Ax cable for continuity.

11. FLOW DIAGRAMS AND SCHEMATICS

APPLICATION		REVISIONS			
NEXT ASSY	USED ON	REV.	DESCRIPTION	DATE	APPROVED
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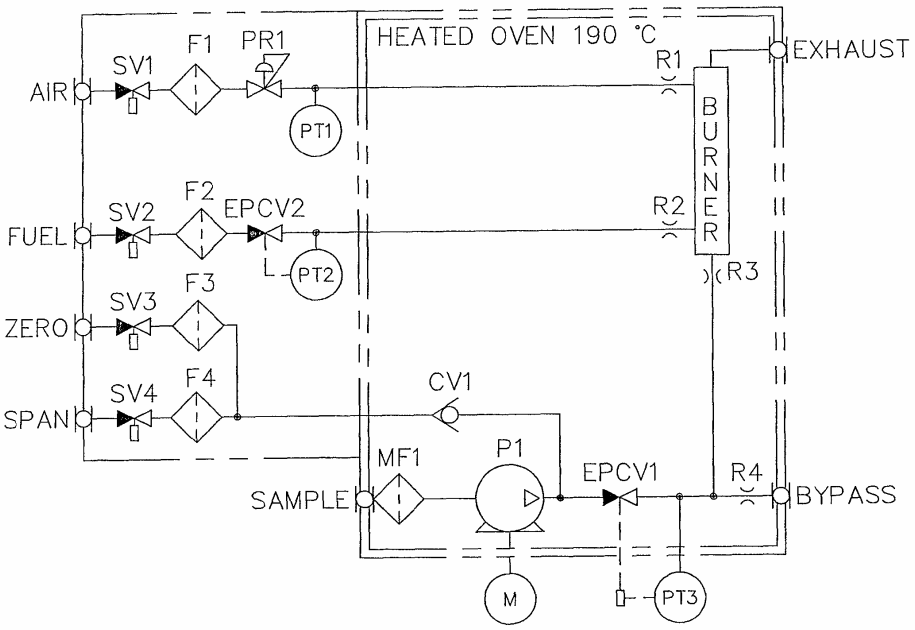
		C	REVISED & REDRAWN	6-21-00	G. DEMINT



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm] TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± .XX± ± .XXX±	CONTRACT NO.		CALIFORNIA ANALYTICAL INSTRUMENTS
	APPROVALS	DATE	FLOW DIAGRAM, 300-HFID
MATERIAL	DRAWN D.B. WHITE	6-12-95	
FINISH	CHECKED D.B. WHITE	6-12-95	SIZE A / FSCM NO. / DWG. NO. 210012 / REV. C
DO NOT SCALE DRAWING	ISSUED		SCALE / SHEET

APPLICATION		REVISIONS			
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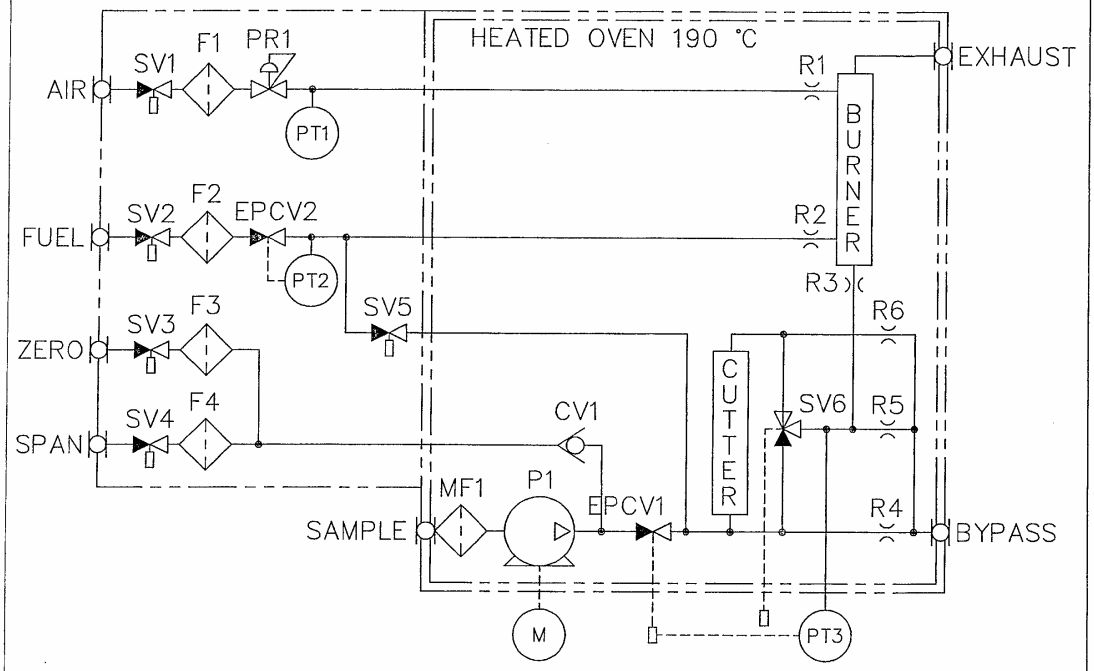

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MATERIAL	APPROVALS / DRAWN D.B. WHITE	DATE 2-20-96	FLOW DIAGRAM, 300M-HFID
FINISH	CHECKED D.B. WHITE	2-20-96	SIZE A / FSCM NO. / DWG. NO. 210021 / REV. B
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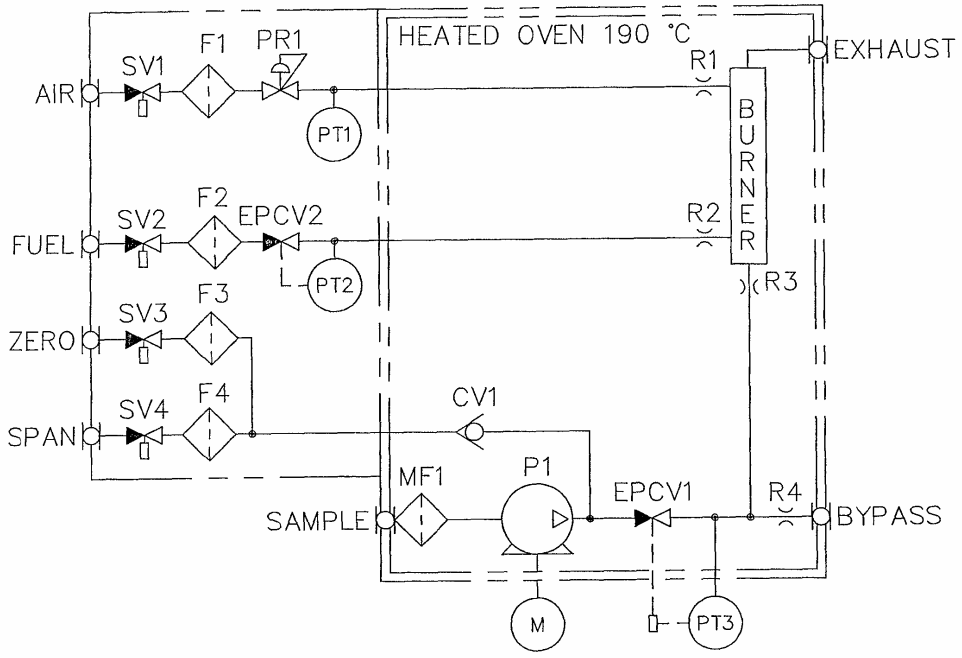

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	APPROVALS	DATE	FLOW DIAGRAM, 300-HFID
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FINISH	CHECKED D.B. WHITE	6-12-95	SIZE A / FSCM NO. / DWG. NO. 210012 / REV. C
DO NOT SCALE DRAWING	ISSUED		SCALE / SHEET

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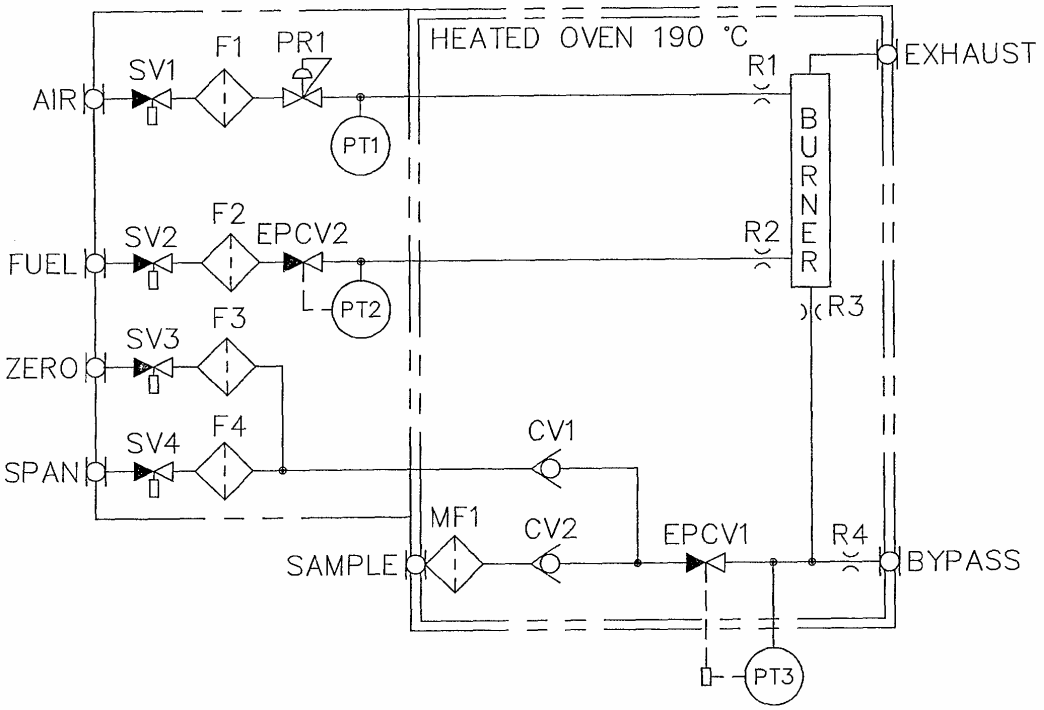

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	APPROVALS	DATE	FLOW DIAGRAM, 300S-HFID
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FINISH	CHECKED G. DEMINT	6-21-00	SIZE A / FSCM NO. / DWG. NO. 210037 / REV.
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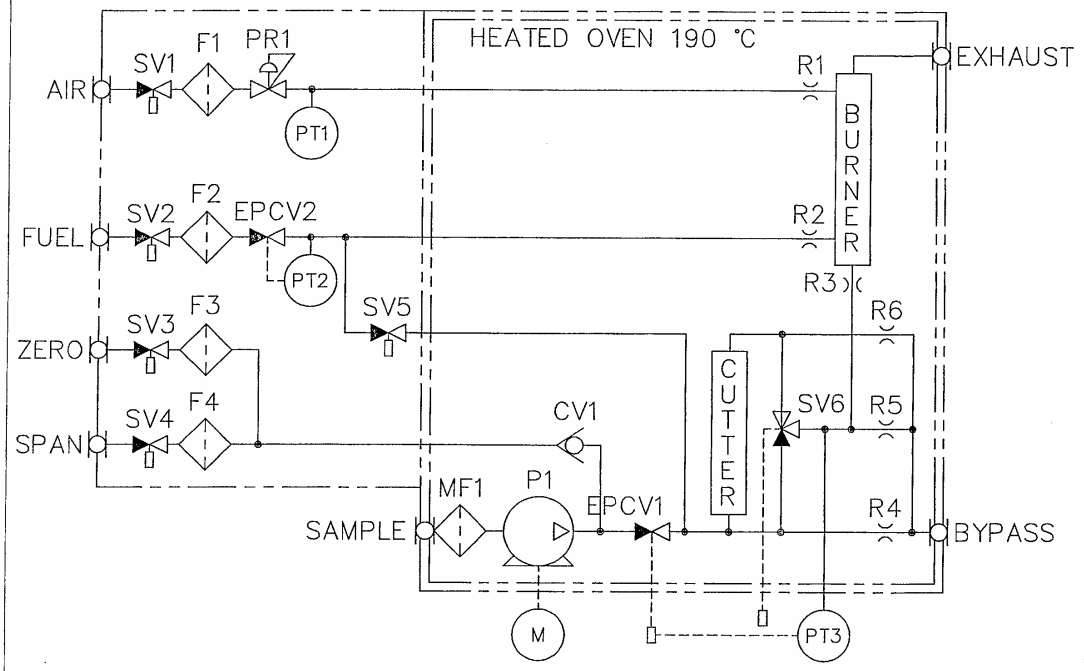

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MATERIAL	APPROVALS / DRAWN D.B. WHITE	DATE 2-20-96	FLOW DIAGRAM, 300M-HFID
FINISH	CHECKED D.B. WHITE	2-20-96	SIZE A / FSCM NO. / DWG. NO. 210021 / REV. B
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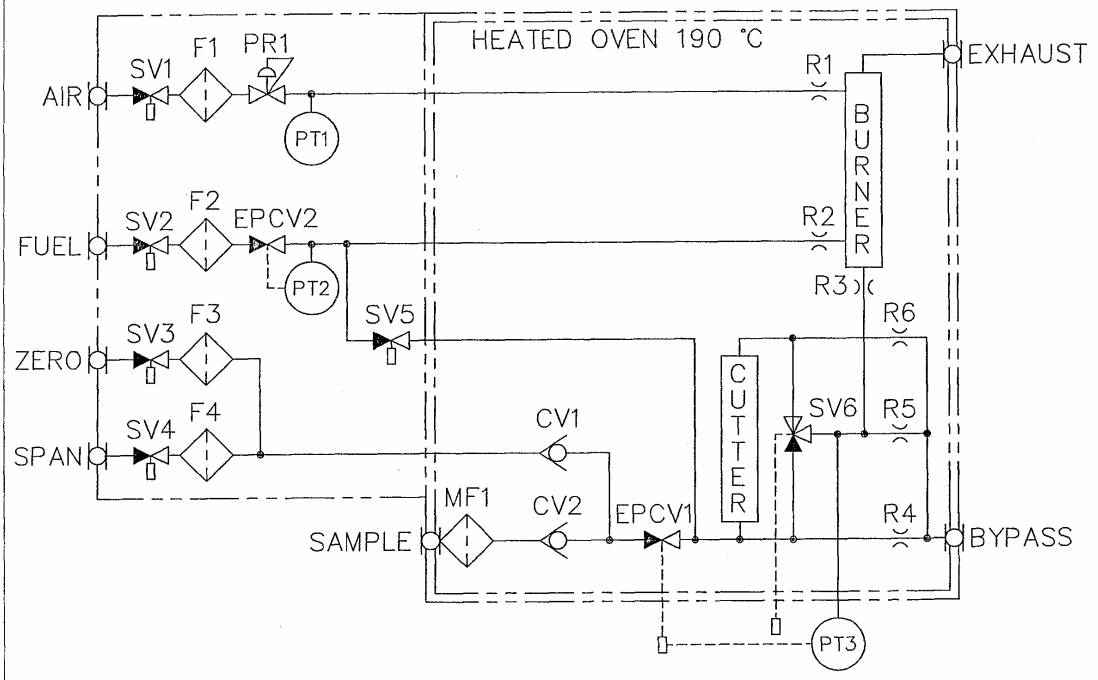

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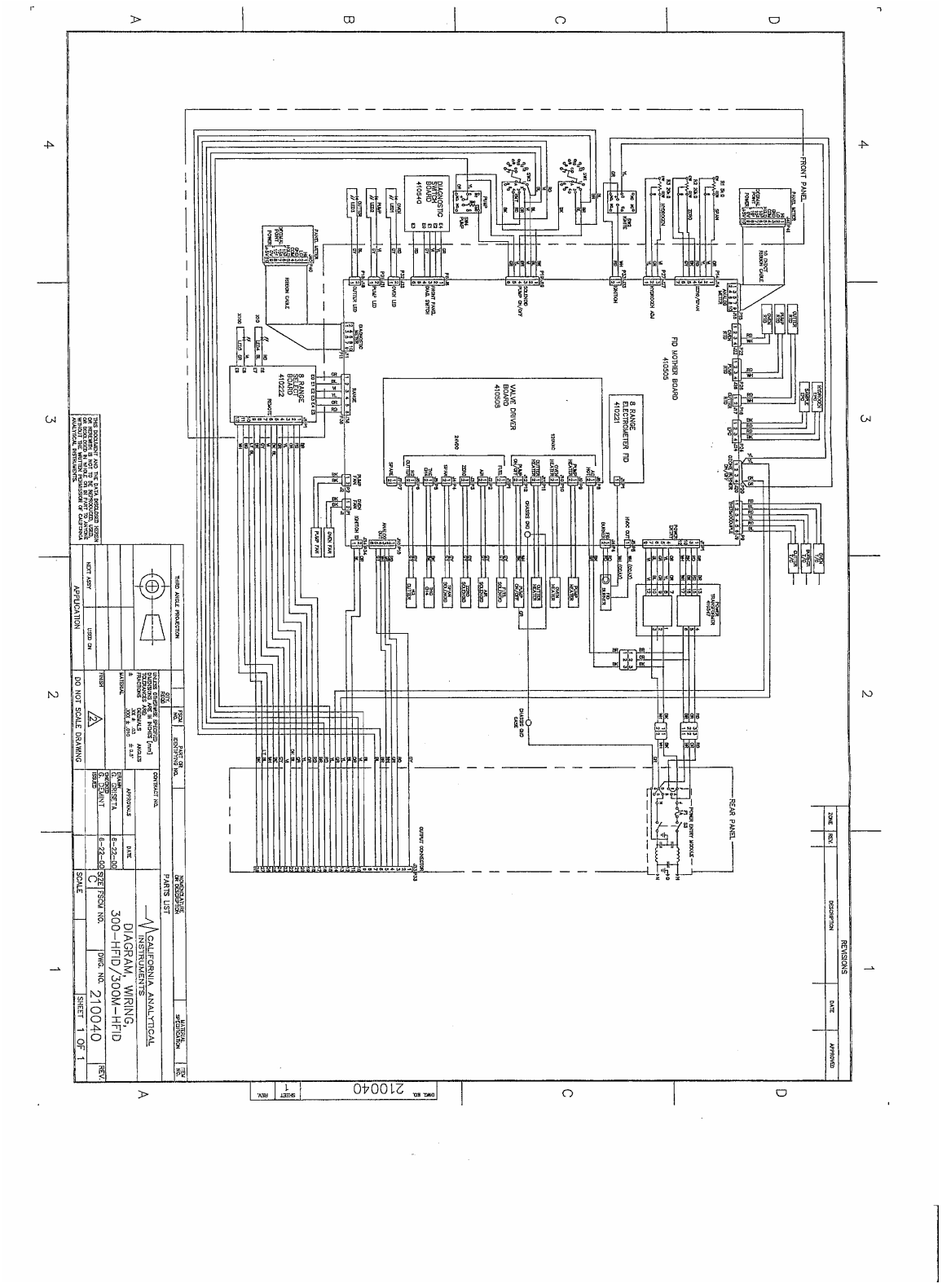
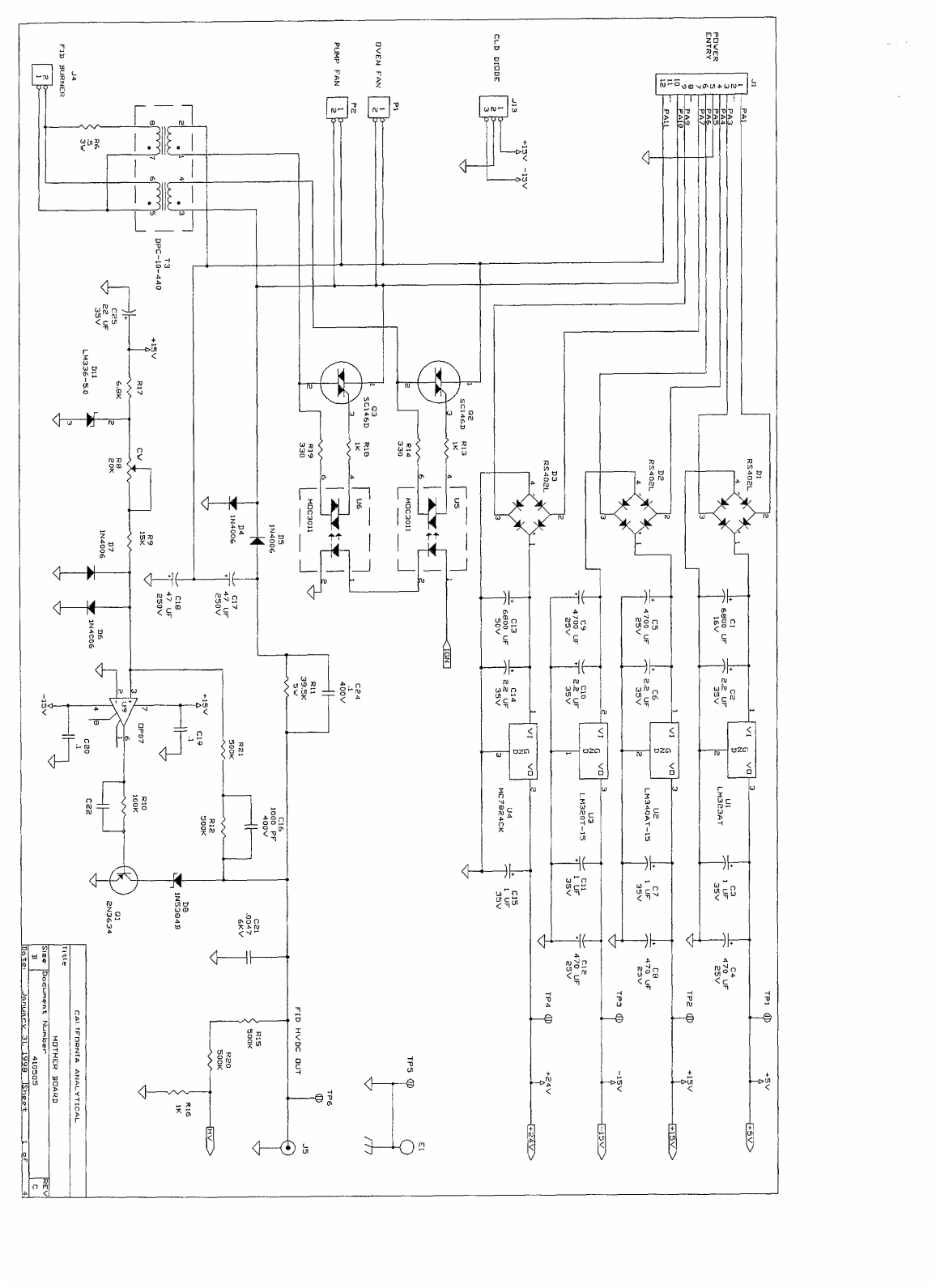

CALIFORNIA ANALYTICAL INSTRUMENTS
DIAGRAM, WIRING, 300-HFID/300M-HFID
DWG. NO. 210040
SIZE C
SCALE
SHEET 1 OF 1
REV. C
6-22-00
DO NOT SCALE DRAWING
FRONT PANEL
REAR PANEL
FID MOTHER BOARD 410505
VALVE DRIVER BOARD 410303
PREAMP ELECTROMETER FID 410221
DIAGNOSTIC DISPLAY BOARD 410540
REVISIONS


FID BURNER
J4
PUMP FAN
OVEN FAN
CLD DIODE
POWER ENTRY
J1
P2
P1
J13
T3
DPC-10-440
R6
5
3W
C25
22 UF
35V
+15V
U11
LM336-5.0
R17
6.8K
CV
R9
20K
R9
15K
D7
1N4006
D6
1N4006
D4
1N4006
D5
1N4006
C18
47 UF
250V
C17
47 UF
250V
Q3
SC146D
Q2
SC146D
R19
330
R10
1K
R14
330
R13
1K
U5
MDC3011
U5
MDC3011
D3
RS402L
D2
RS402L
D1
RS402L
C13
6800 UF
50V
C14
2.2 UF
35V
C9
4700 UF
25V
C10
2.2 UF
35V
C5
4700 UF
25V
C6
2.2 UF
35V
C1
6800 UF
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C2
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35V
U4
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R21
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R12
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C16
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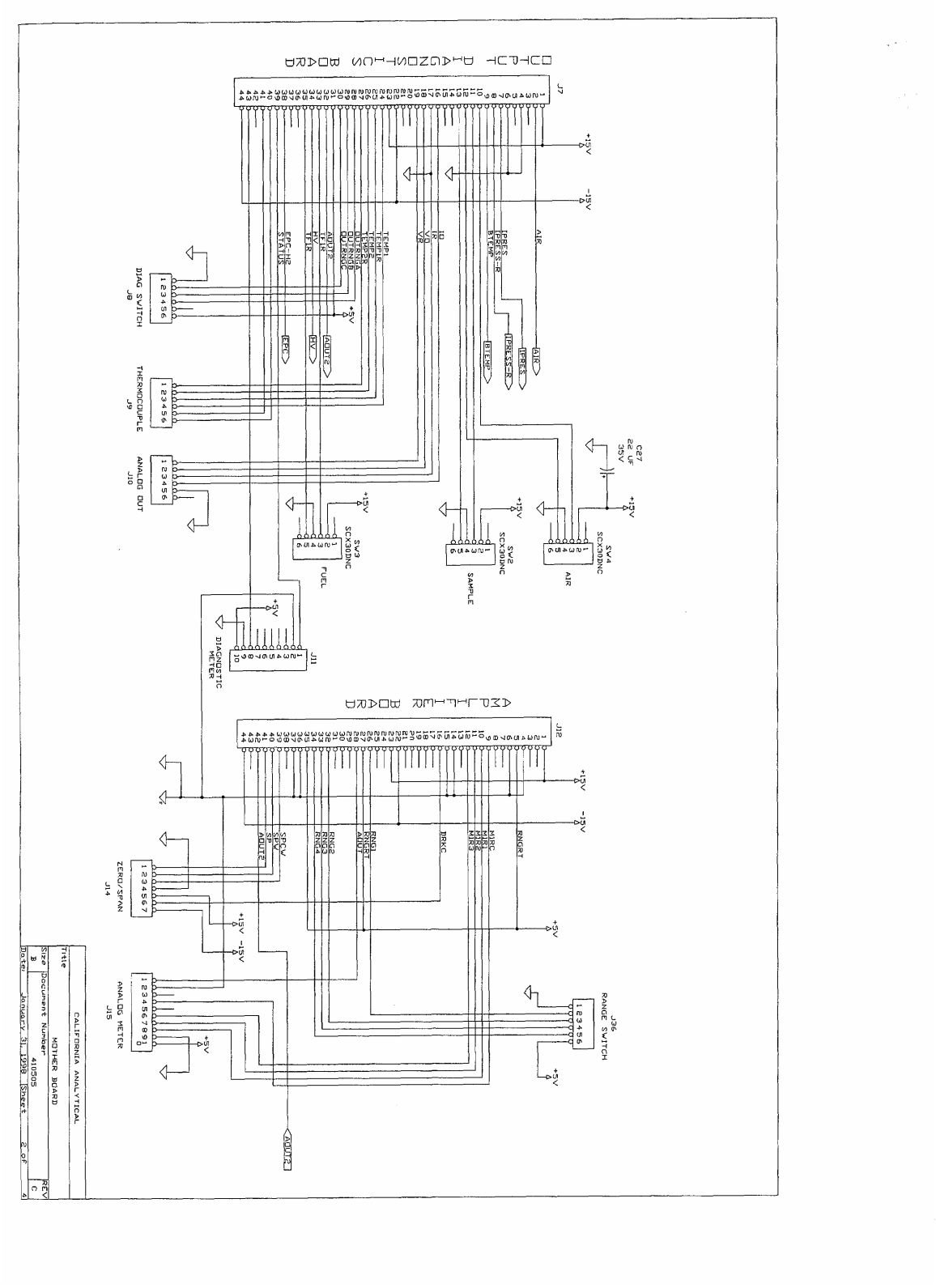
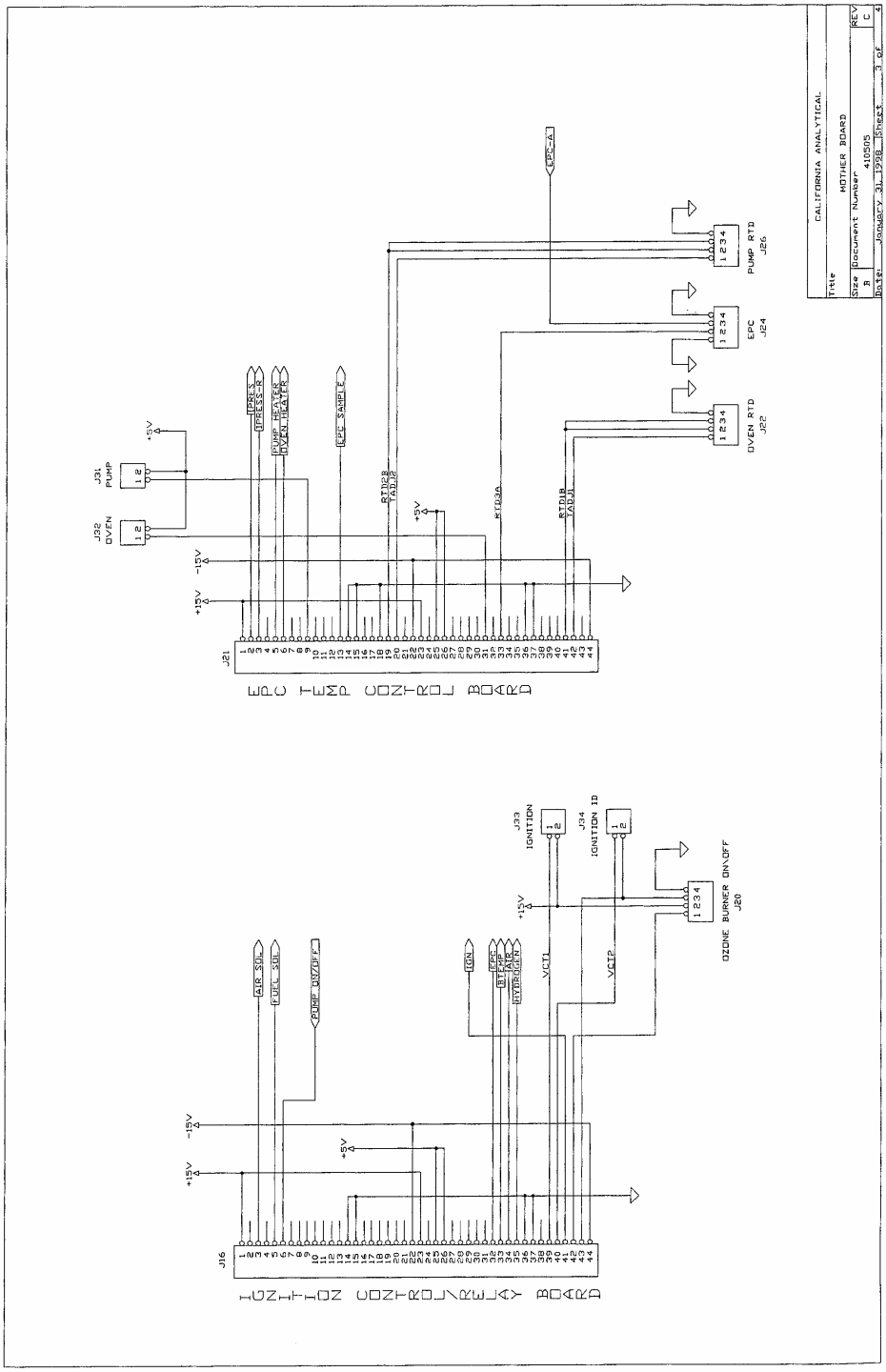
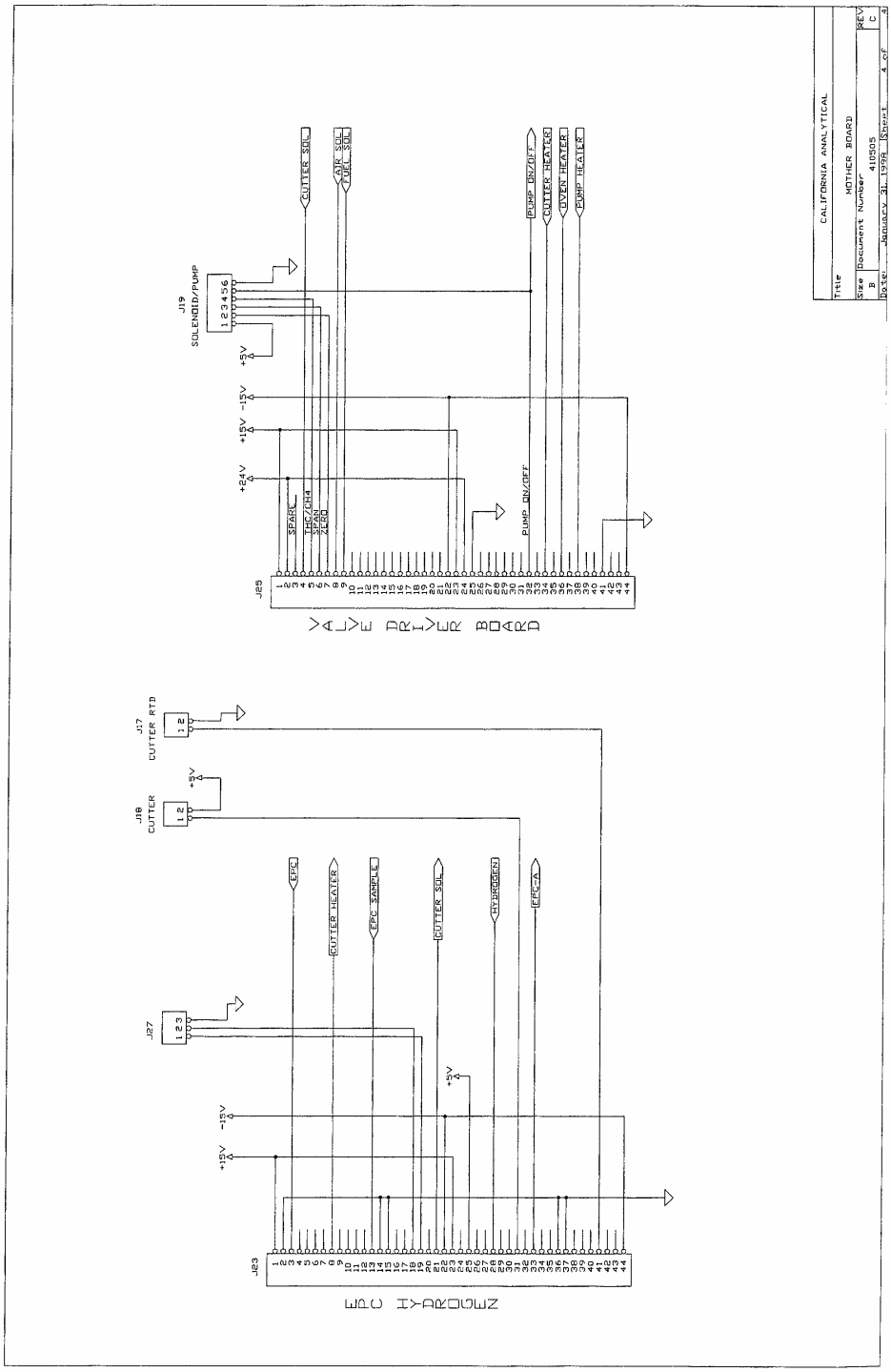
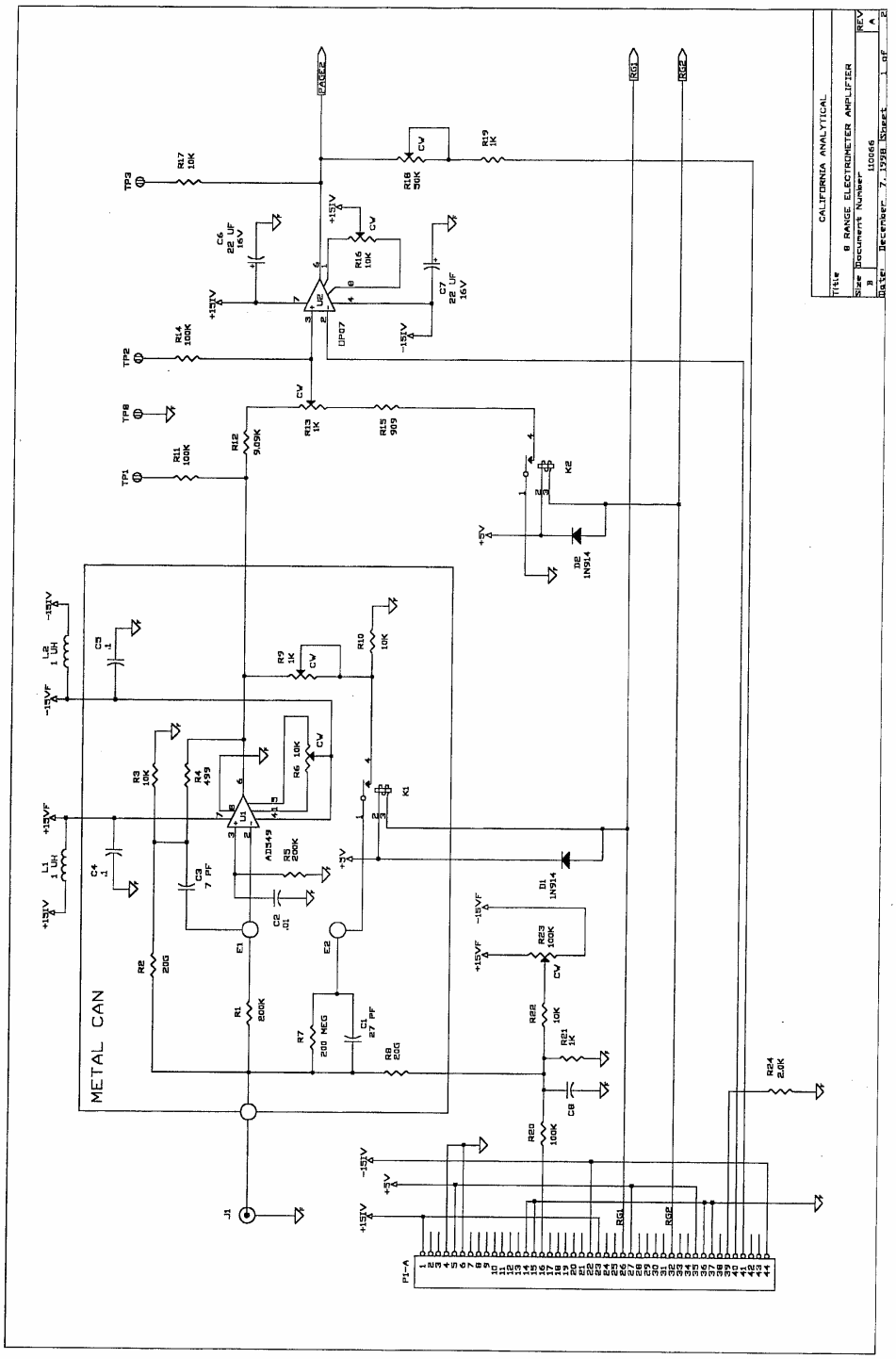
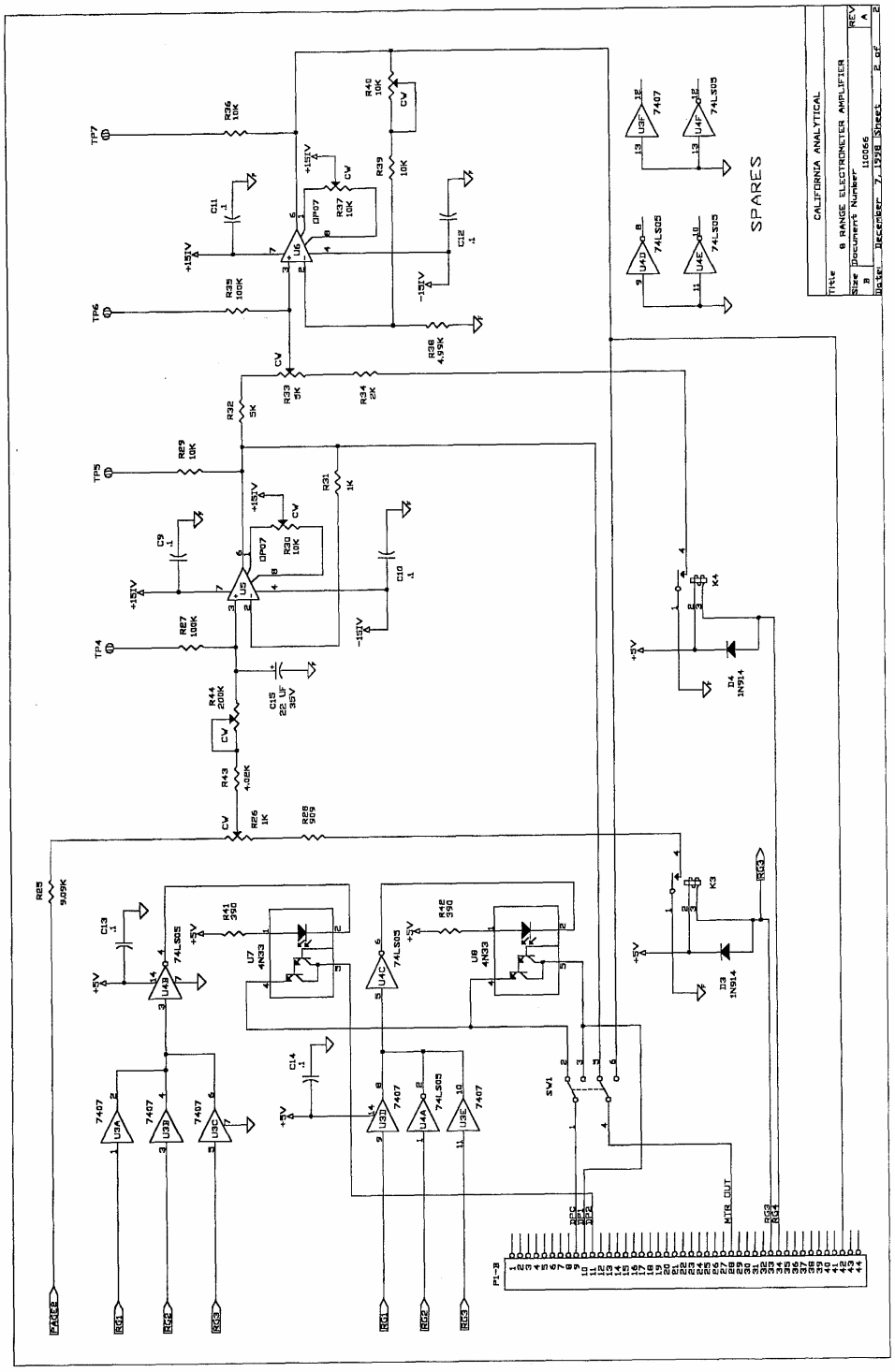
C21
.047
6KV
R15
50MK
R20
500K
R16
1K
-5V
FID HVDC OUT
TP6
J5
TP5
E1
CALIFORNIA ANALYTICAL
Title
MOTHER BOARD
Size
B
Document Number
410505
Rev
C
Date: January 31, 1998
Sheet 1 of 1

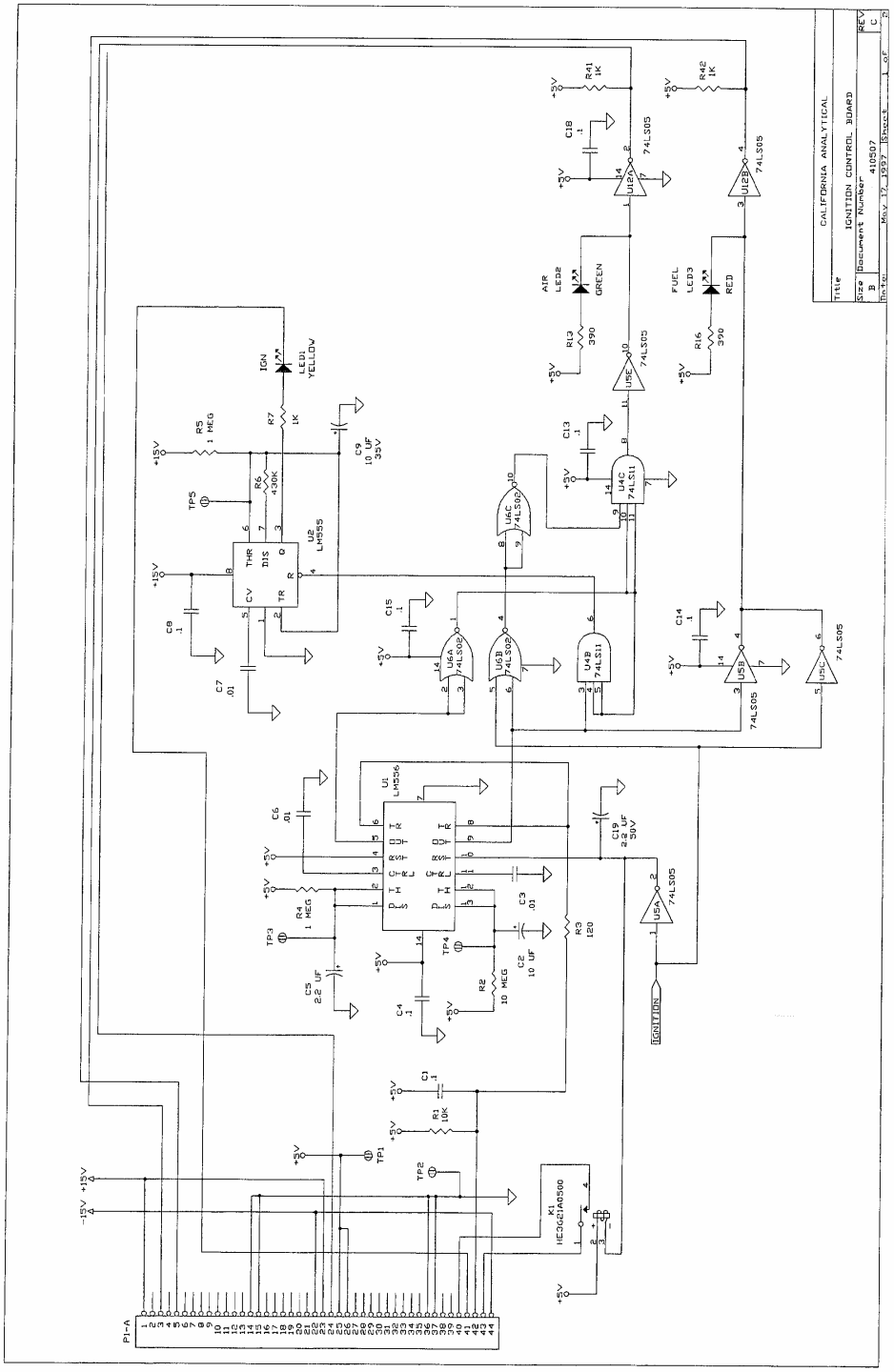

CALIFORNIA ANALYTICAL
MOTHER BOARD
Document Number
410505
Rev
C
Date: January 31, 1998
Sheet 2 of 4
DIAG SWITCH
J9
THERMOCOUPLE
J9
ANALOG OUT
J10
DIAGNOSTIC METER
J11
FUEL
SAMPLE
AIR
ZERO/SPAN
J14
ANALOG METER
J15
RANGE SWITCH
J36
+15V
-15V
+5V

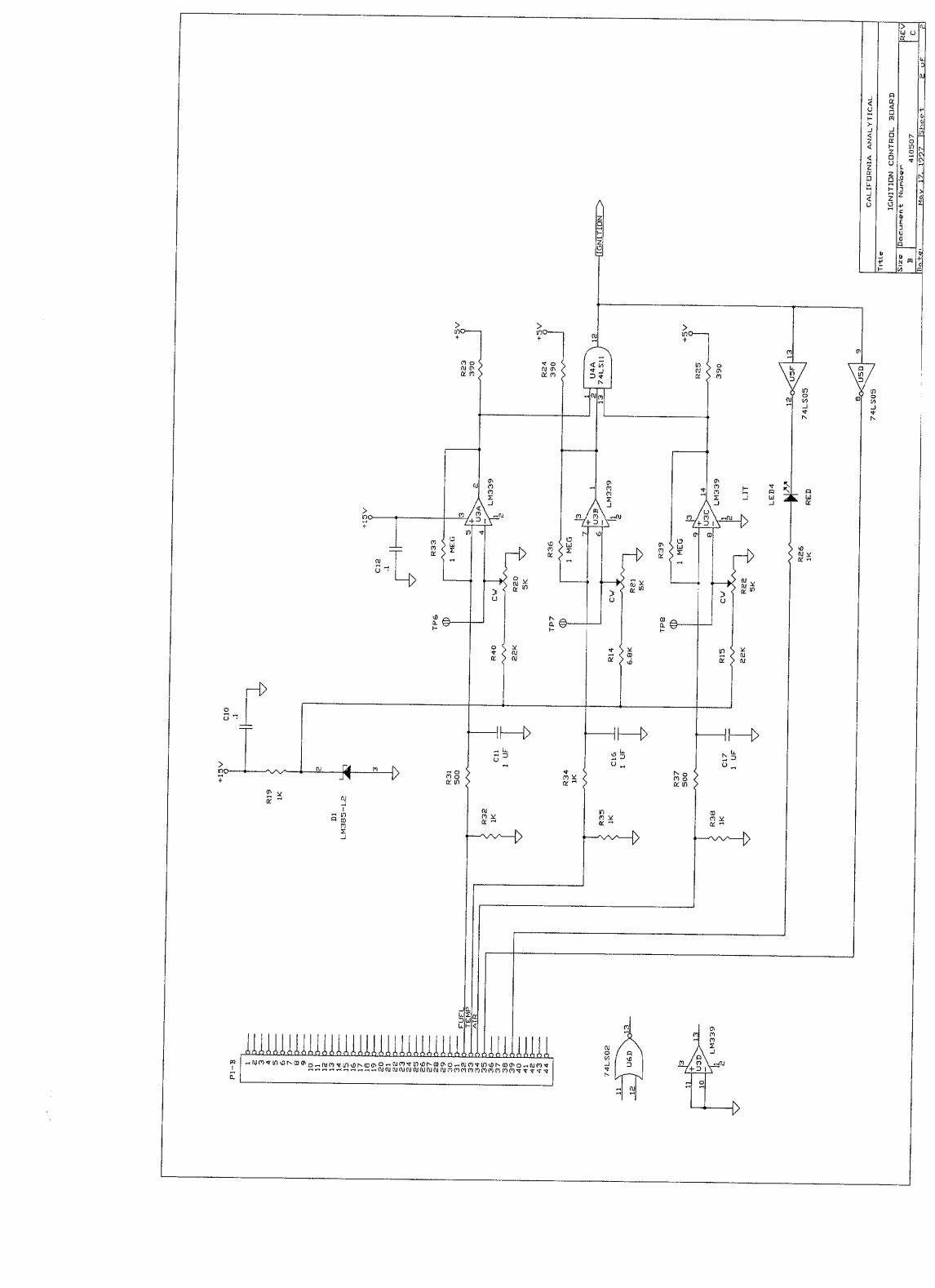

CALIFORNIA ANALYTICAL
MOTHER BOARD
EPC-A1
PUMP RTD J26
EPC J24
OVEN RTD J22
EPC TEMP CONTROL BOARD
IGNITION
IGNITION ID
OZONE BURNER ON/OFF J28
AIR SOL
FUEL SOL
PUMP ON/OFF
IGN
VCT1
VCT2
HYDROGEN
FLOW CONTROL RELAY BOARD

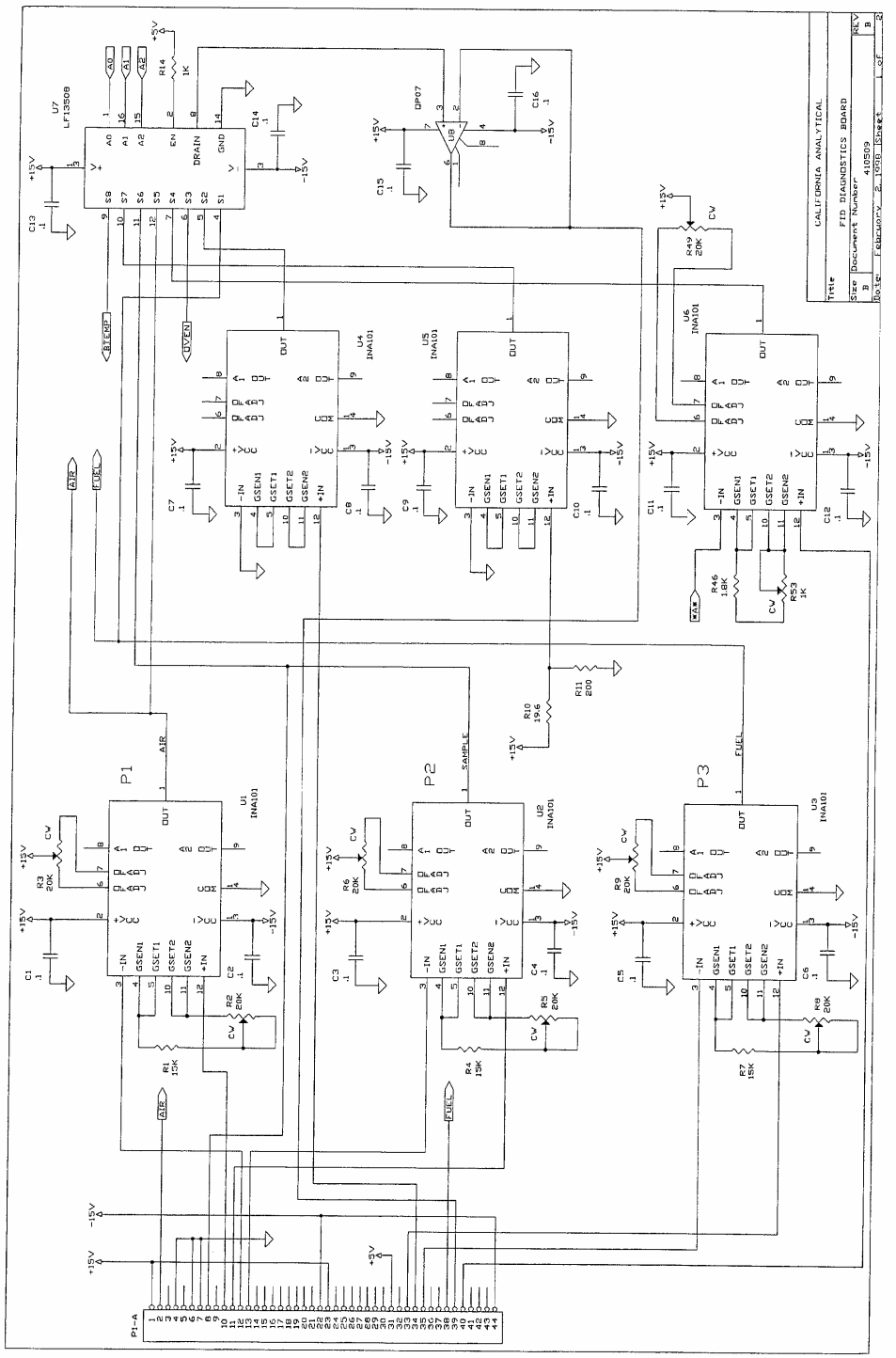

CALIFORNIA ANALYTICAL
Title
MOTHER BOARD
Size B
Document Number 410505
REV C
Date: January 31, 1996
Sheet 4 OF 4
VALVE DRIVER BOARD
J19
SOLENOID/PUMP
J25
J7
CUTTER RTD
J8
CUTTER
J27
J23
EPC HYDROGEN
CUTTER SOL
AIR SOL
FUEL SOL
PUMP ON/OFF
CUTTER HEATER
OVEN HEATER
PUMP HEATER
+5V
-15V
+15V
+24V
SPARE
THC/CH4
SPAN
ZERO
EPC
EPC SAMPLE
HYDROGEN
EPC-A

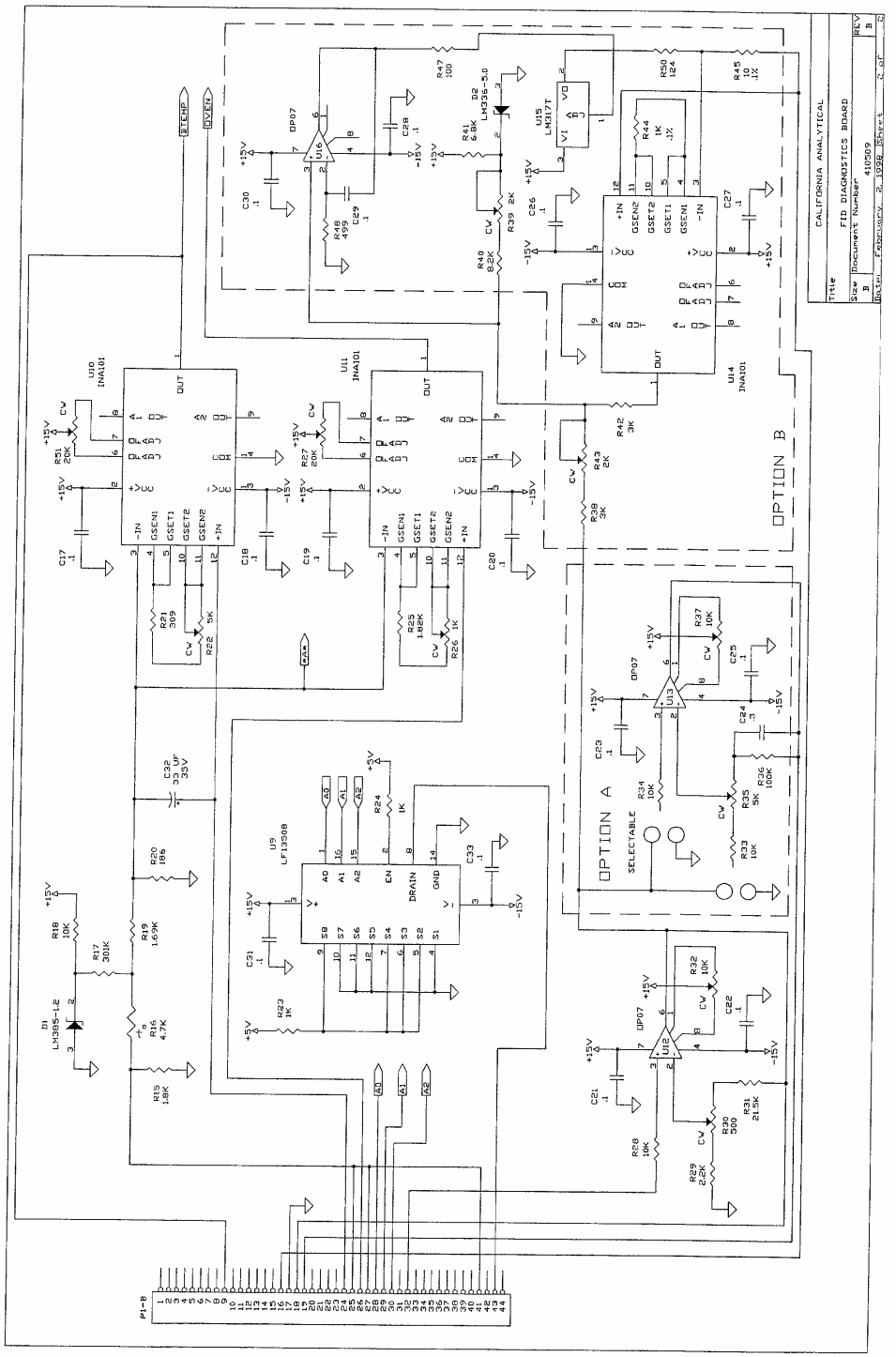

CALIFORNIA ANALYTICAL
8 RANGE ELECTROMETER AMPLIFIER
Document Number 110066
Date: December 7, 1998 Sheet 1 of 2
METAL CAN
CAGE
RG1
RG2
U1
U2
AD549
LM607
K1
K2
D1 1N914
D2 1N914
P1-A
J1
TP1
TP2
TP3
TP8
+15V
-15V
+5V
CV

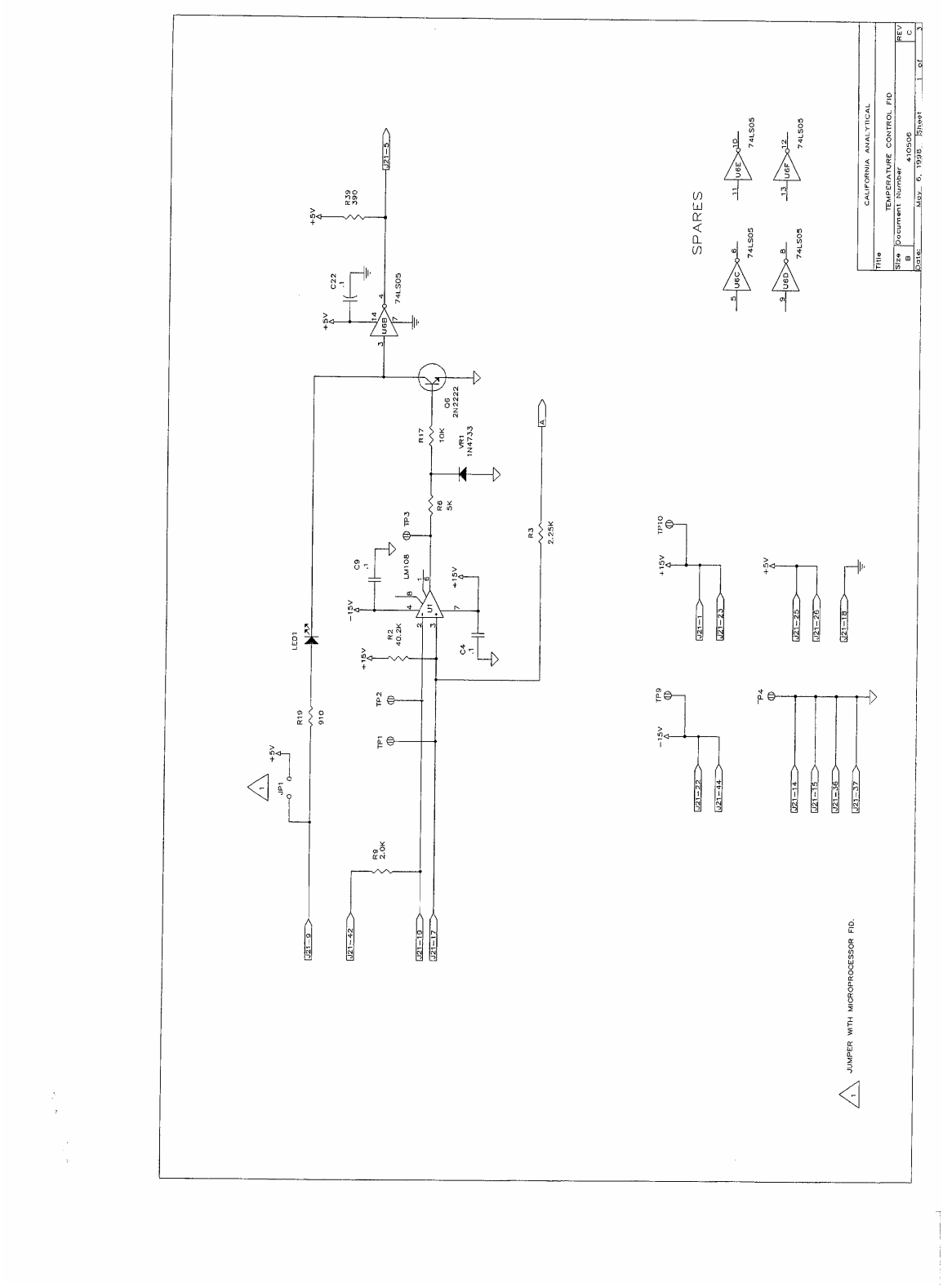

CALIFORNIA ANALYTICAL
Title 6 RANGE ELECTROMETER AMPLIFIER
Size B Document Number 100646 REV A
Date: December 7, 1998 Sheet 2 of 2
SPARES
MTR OUT
P1-B

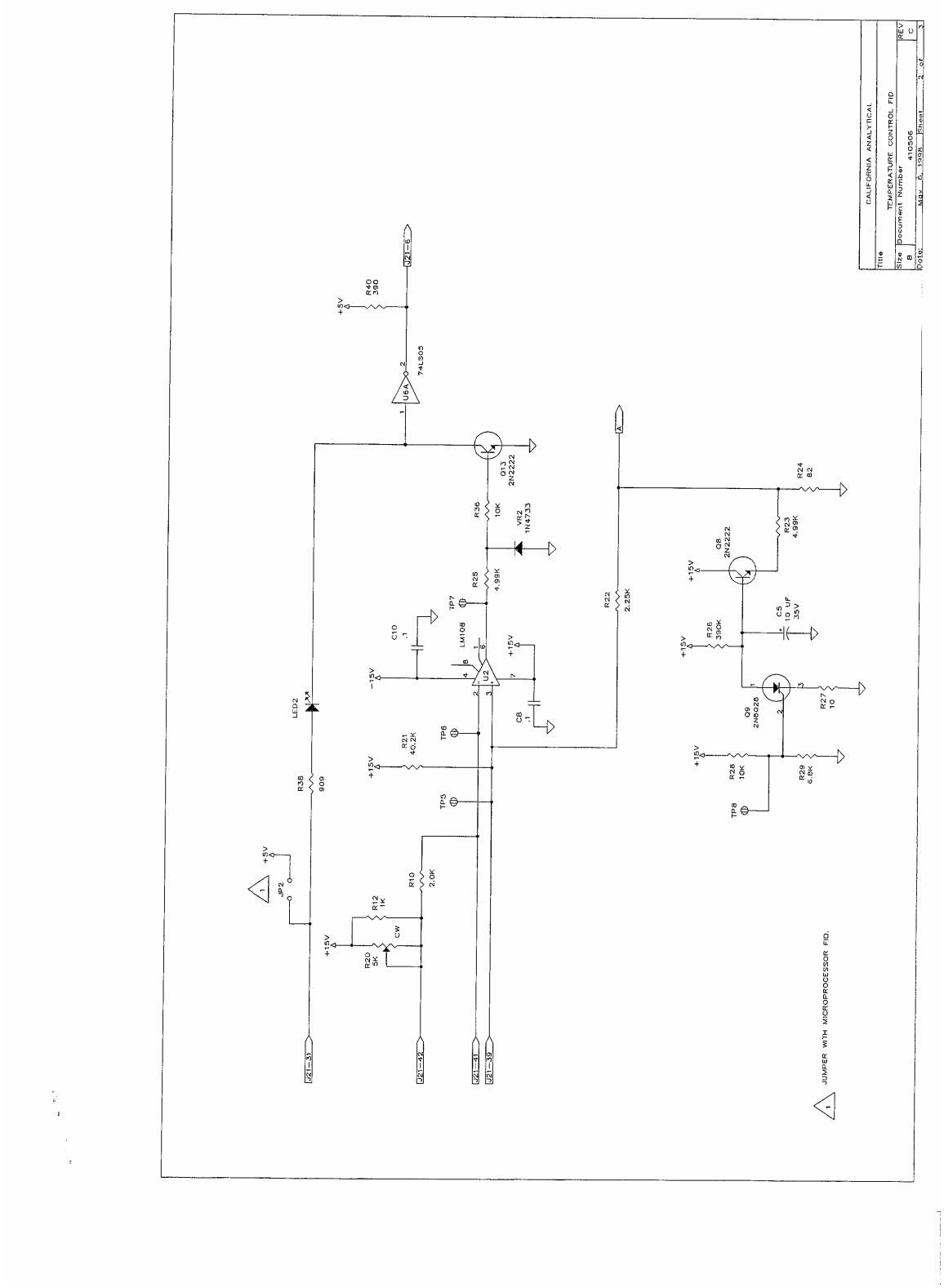

CALIFORNIA ANALYTICAL
IGNITION CONTROL BOARD
Document Number 410507
REV C
IGNITION
IGN
LED1 YELLOW
AIR LED2 GREEN
FUEL LED3 RED
U1 LM336
U2 LM555
P1-A
K1 HE3621A0500

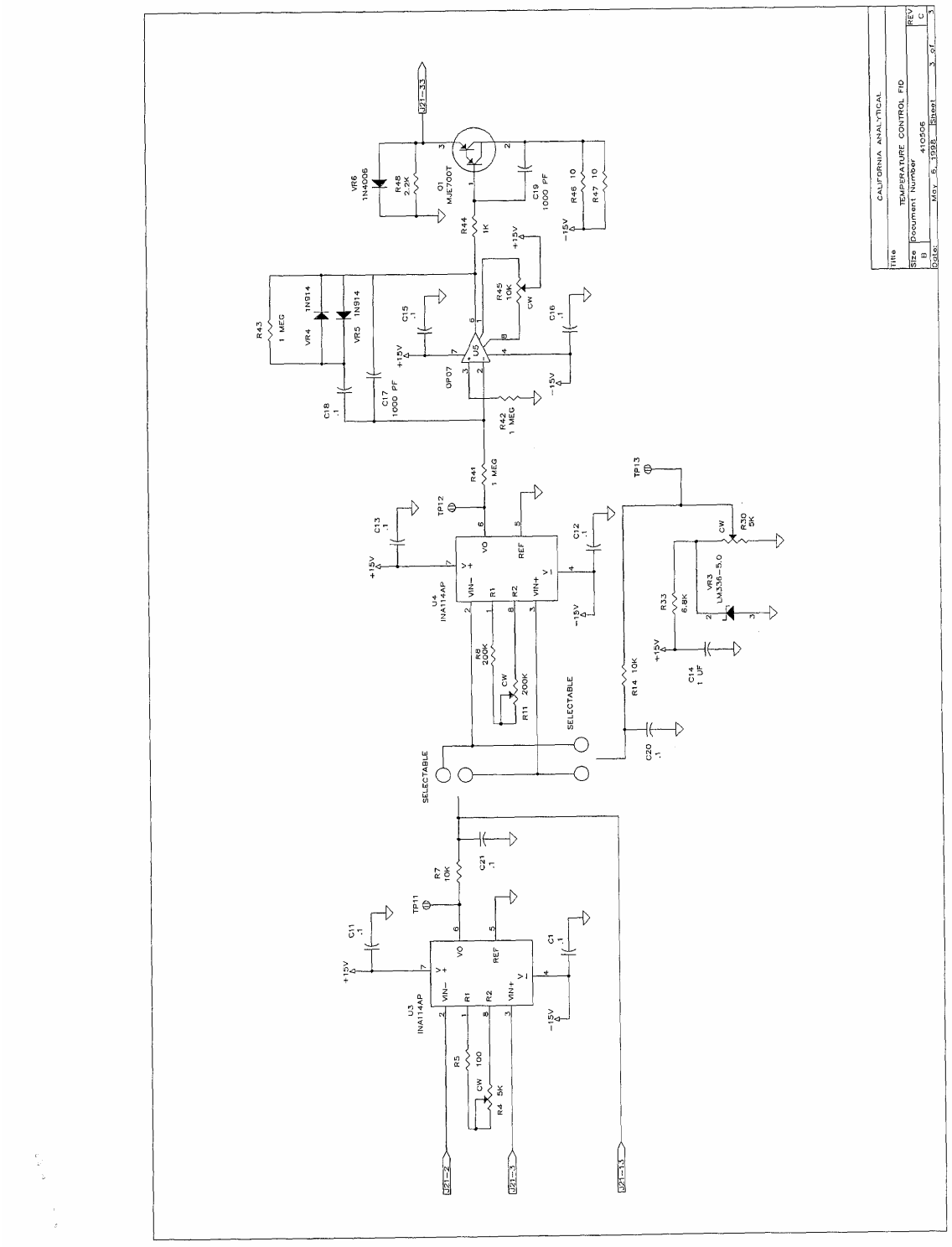

CALIFORNIA ANALYTICAL
IGNITION CONTROL BOARD
Document Number 410507
IGNITION
+5V
+15V
R23 390
R24 390
R25 390
U4A 74LS11
74LS05
LED4
RED
LIT
R33 1 MEG
R36 1 MEG
R39 1 MEG
R26 1K
R20 5K
R21 5K
R22 5K
R40 22K
R14 6.8K
R15 22K
C12 .1
C10 .1
C11 1 UF
C16 1 UF
C17 1 UF
R31 500
R34 1K
R37 500
R19 1K
R32 1K
R35 1K
R38 1K
D1 LM385-1.2
TP6
TP7
TP8
P1-B
FUEL
FLAME
74LS02

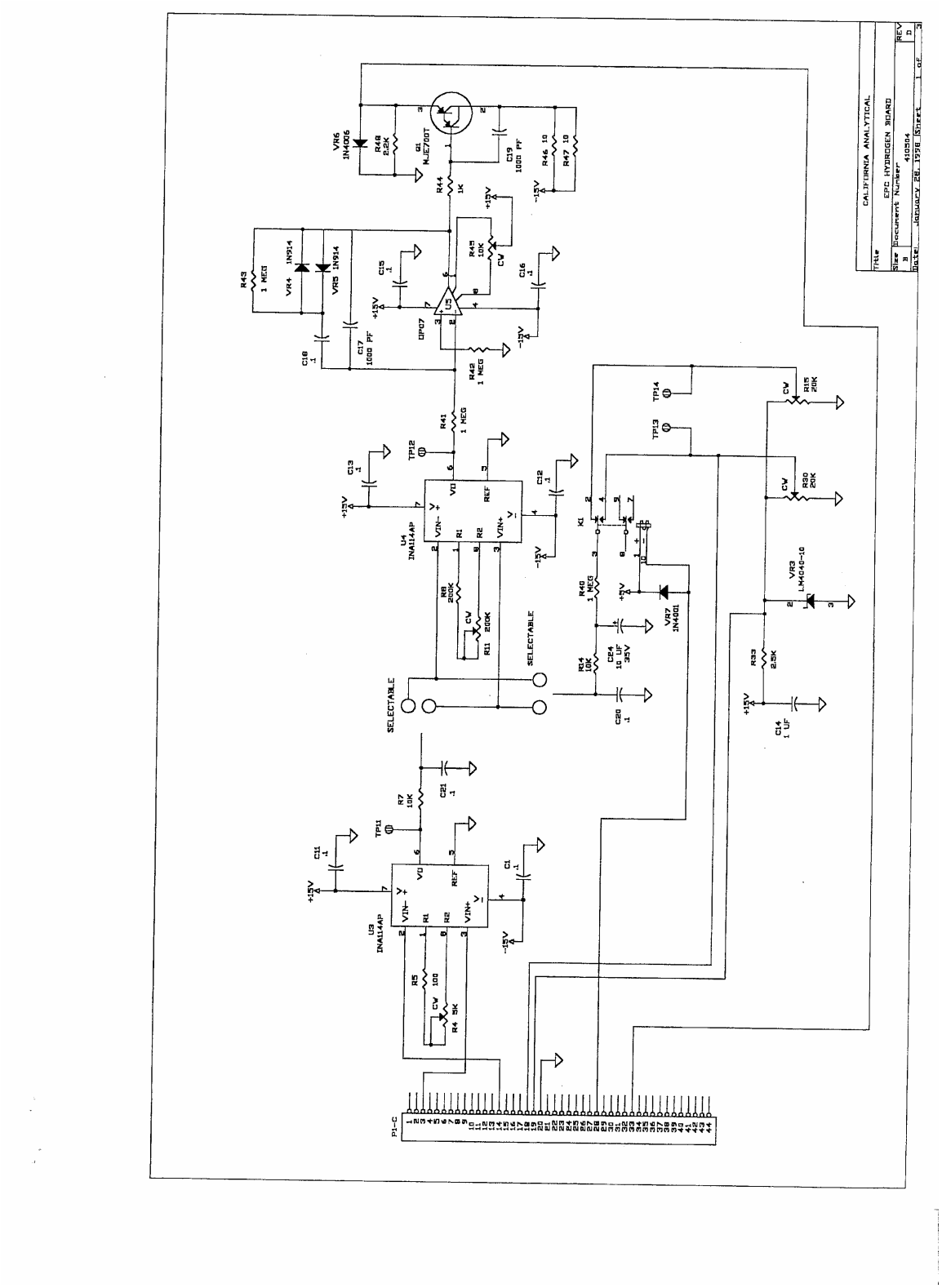

CALIFORNIA ANALYTICAL
FID DIAGNOSTICS BOARD
Document Number 410509
P1
P2
P3
AIR
FUEL
SAMPLE
U1 INA101
U2 INA101
U3 INA101
U4 INA101
U5 INA101
U6 INA101
U7 LF13508
U8 OP07
+15V
-15V
+5V
CV
R1 15K
R2 20K
R3 20K
R4 15K
R5 20K
R6 20K
R7 15K
R8 20K
R9 20K
R10 196
R11 200
R46 18K
R49 20K
R53 1K
R14 1K
C1 .1
C2 .1
C3 .1
C4 .1
C5 .1
C6 .1
C7 .1
C8 .1
C9 .1
C10 .1
C11 .1
C12 .1
C13 .1
C14 .1
C15 .1
C16 .1
P1-A


CALIFORNIA ANALYTICAL
FID DIAGNOSTICS BOARD
OPTION A
OPTION B
SELECTABLE
TEMP
OVEN
P1-B


CALIFORNIA ANALYTICAL
TEMPERATURE CONTROL PID
Document Number 410506
REV C
SPARES
U6E 74LS05
U6F 74LS05
U6C 74LS05
U6D 74LS05
U6B 74LS05
U6A 74LS05
Q6 2N2222
R17 10K
VR1 1N4733
R6 5K
R3 2.25K
R2 40.2K
R19 910
R9 2.0K
R39 390
C22 .1
C9 .1
C4 .1
LM108
LED1
TP1
TP2
TP3
TP4
TP9
TP10
JP1
+5V
-15V
+15V
J21-9
J21-42
J21-10
J21-17
J21-1
J21-23
J21-25
J21-26
J21-18
J21-22
J21-44
J21-14
J21-15
J21-36
J21-37
JUMPER WITH MICROPROCESSOR FIO.


CALIFORNIA ANALYTICAL
Title
TEMPERATURE CONTROL FID
Size B
Document Number 410505
REV C
Date: May 6, 1998 Sheet 2 of 3
J21-6
+5V
R40 390
U5A 74LS05
Q13 2N2222
R36 10K
VR2 1N4733
R25 4.99K
TP7
C10 .1
LM108
U2
+15V
-15V
C8 .1
LED2
R38 909
TP6
R21 40.2K
TP5
R10 2.0K
R12 1K
CW
R20 5K
JP2
J21-31
J21-42
J21-41
J21-39
R22 2.25K
R24 82
R23 4.99K
Q8 2N2222
R26 390K
C5 10 UF 35V
Q9 2N6026
R27 10
R28 10K
R29 6.8K
TP8
JUMPER WITH MICROPROCESSOR FID.


CALIFORNIA ANALYTICAL
TEMPERATURE CONTROL FID
Document Number 410505
Size B
May 5, 1998
Sheet 3 of 5
REV C
J21-33
VR6 1N4006
R48 2.2K
Q1 MJE700T
C19 1000 PF
R46 10
R47 10
R44 1K
+15V
-15V
R45 10K CW
R43 1 MEG
VR4 1N914
VR5 1N914
C15 .1
C16 .1
C17 1000 PF
C18 .1
U5 OP07
R42 1 MEG
R41 1 MEG
TP12
TP13
C13 .1
C12 .1
U4 INA114AP
VO
REF
VIN-
VIN+
R1
R2
R8 200K
R11 200K CW
SELECTABLE
R30 5K CW
VR3 LM336-5.0
R33 6.8K
C14 1 UF
R14 10K
C20 .1
R7 10K
C21 .1
TP11
C11 .1
C1 .1
U3 INA114AP
R5 100 CW
R4 5K
J21-2
J21-3
J21-13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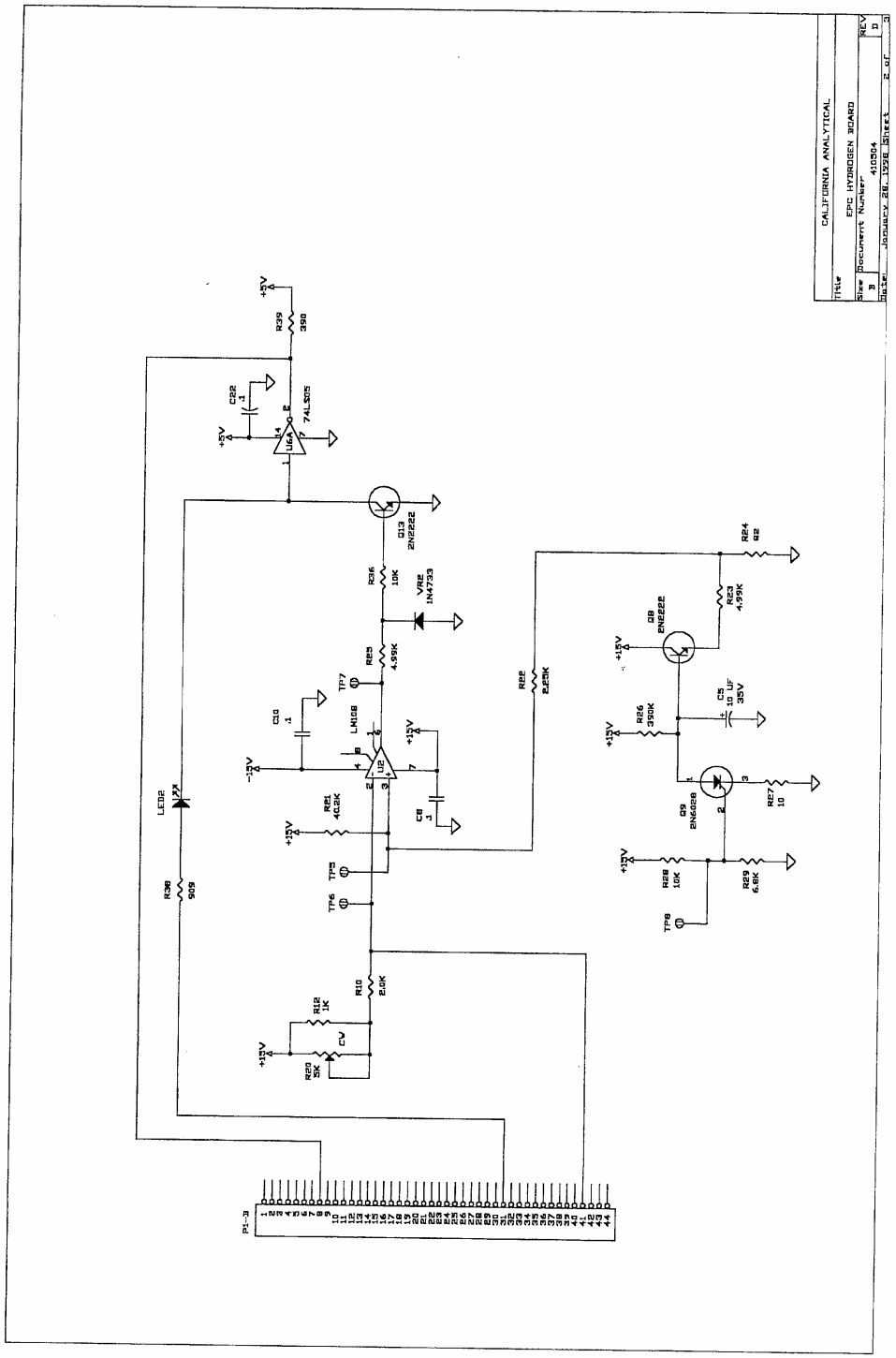
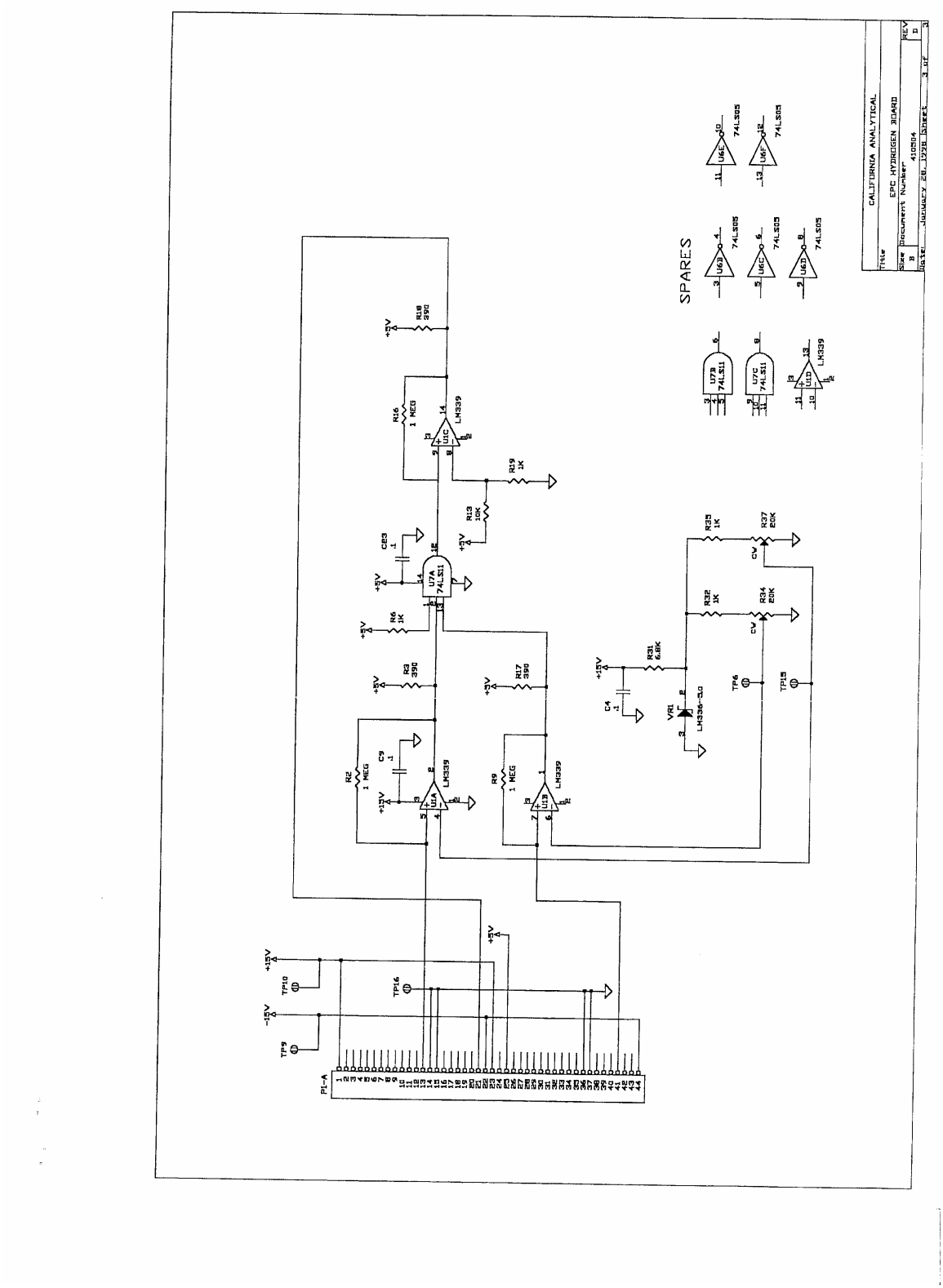
EPC HYDROGEN BOARD
SELECTABLE
SELECTABLE


CALIFORNIA ANALYTICAL
EPC HYDROGEN BOARD
Document Number 410304
R39 390
C22 .1
U6A 74LS05
Q13 2N2222
R36 10K
VR2 1N4733
R23 4.99K
TP7
C10 .1
LM108
U2
R21 40.2K
C8 .1
LED2
R30 909
TP5
TP6
R10 2.0K
R12 1K
CV
R28 5K
R22 2.87K
R24 82
R33 4.99K
Q8 2N6028
C5 10 UF 35V
R26 390K
Q9 2N6028
R27 10
R28 10K
R29 6.8K
TP8
P1-3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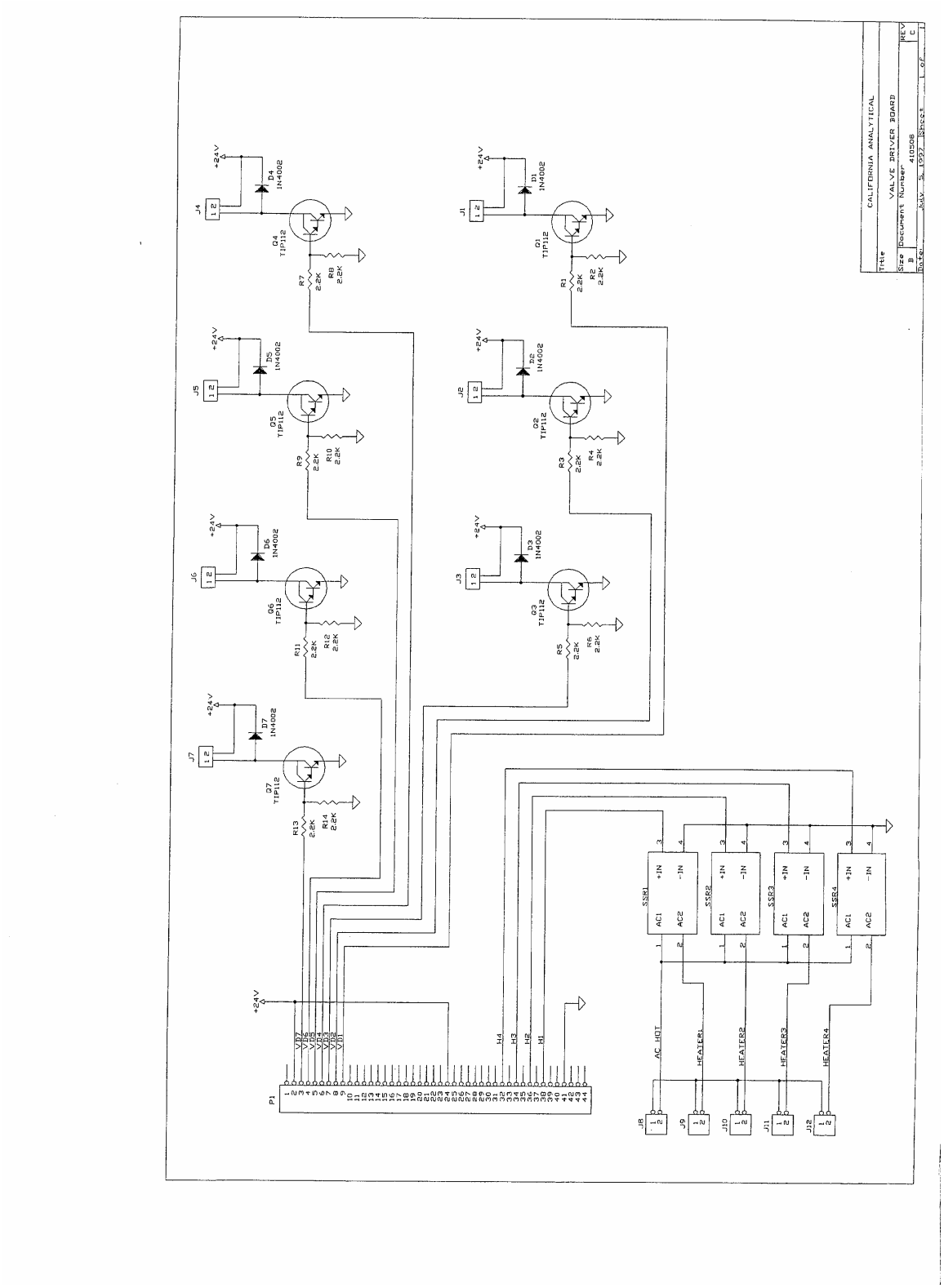
410504
SPARES
74LS05
74LS11
LM339
LM336-5.0
P1-A


CALIFORNIA ANALYTICAL
VALVE DRIVER BOARD
Document Number 410508
+24V
TIP112
1N4002
AC_HOT
HEATER1
HEATER2
HEATER3
HEATER4