



MONTGOMERY WATSON

00-000-3

August 28, 1997

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Michael Bellot, Project Manager  
United States Environmental Protection Agency, Region 5  
77 West Jackson Boulevard  
Chicago, Illinois 60604-3590

Re: Addenda to Sampling Plans  
Proposed Investigation of North Stormwater Pipe,  
and Surface Water Sampling of Sand Pond  
Blackwell Forest Preserve Landfill  
DuPage County, Illinois

EPA Region 5 Records Ctr.



248054

Dear Mr. Bellot:

On behalf of the Forest Preserve District of DuPage County (FPD), we are enclosing Addenda to previous U.S. EPA approved sampling plans for the Blackwell Landfill. We are submitting these Addenda in response to your June 16, 1997 letter in which you requested that the FPD conduct a subsurface soils investigation at the North Stormwater Pipe's discharge point should recent sampling indicate contaminants in the Pipe. These addenda also satisfy your July 15, 1997 suggestion to the FPD that a surface water and sediment sample be collected from Sand Pond prior to the FPD redeveloping the pond area for public access.

**Subsurface Soil Investigation of North Stormwater Pipe**

The North Stormwater Pipe was installed by the FPD in 1982 to redirect stormwater off the landfill and into a grove of trees located north of the landfill. The Pipe was installed at a depth of two to four feet with manholes regularly spaced along the pipeline. The Pipe discharged stormwater into the grove of trees via a five to seven foot deep perforated pipe located between manholes MH-1 and MH-2.

On April 23, 1997, Montgomery Watson collected groundwater samples from manhole MH-3, and analyzed these samples for Target Compound List (TCL) volatile and semivolatile organic compounds (TCL-VOCs and TCL-SVOCs, respectively), Target Analyte List (TAL) metals and cyanide, and major ions. The analytical results were submitted to the U.S. EPA in a June 9, 1997 letter, and indicated the presence of three TCL-VOCs and a TCL-SVOC. Since contaminants have been detected in the North Stormwater Pipe, we will, in accordance with your June 16, 1997 letter, conduct a subsurface soils investigation in the grove of trees between existing manholes MH-1 and MH-2. The purpose of this investigation will be to determine the subsurface impacts, if any, of the stormwater discharges.

The subsurface soils investigation will initially consist of advancing two continuously sampled stratigraphic soil borings at the one-third and two-thirds distances between manholes MH-1 and MH-2. After evaluating the stratigraphy, a second borehole will be advanced at each location to collect soil samples for analytical testing. The stratigraphic borings will be advanced to a depth equal to, or just greater than, the depth of the discharge pipe. The discharge pipe extends to a depth of 7.8 and 5.1 feet below existing ground surface at manholes MH-1 and MH-2, respectively. Each subsurface soil sample from the stratigraphic soil boring will be visually inspected and screened for headspace analysis using a photoionization detector.

The two additional borings will be drilled within five feet of the stratigraphic borings for the collection of subsurface samples for analytical testing. Only one soil sample (plus appropriate quality assurance sample volume) will be collected from each soil boring, and it is anticipated that this sample will be collected from a depth equal to, or just greater than, the depth of the perforated discharge pipe. However, if a shallower stratigraphic soil sample shows visible evidence of impacts and has a high headspace reading, the shallower soil sample will be submitted for analysis instead. The collected soil sample will be submitted to First Environmental Laboratories for analysis of TCL-VOCs, TCL-SVOCs, and TAL metals and cyanide using SW-846 methodologies.

#### **Surface Water and Sediment Sampling of Sand Pond**

A surface water and sediment sample will be collected from Sand Pond during the next round of Quarterly Groundwater Sampling. The surface water and sediment sample will be collected from the northwest side of the pond nearest Blackwell Landfill. A background groundwater and two background sediment samples will be collected from Pine Lake (i.e. located south of Sand Pond). Surface water and sediment samples will be analyzed for TCL-VOCs, TCL-SVOCs, and TAL metals and cyanide using SW-846 methodologies.

#### **Field Sampling Plan, Quality Assurance Project Plan, and Site Safety Plan**

Both the North Stormwater Pipe and Sand Pond surface water investigations will be conducted in general accordance with the approved August 1996 Work Plans for the Pre-Design Investigations (i.e., Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP), and the Site Safety Plan (SSP)). Sediment sampling will be conducted in general accordance with the August 1990 Work Plan for the Remedial Investigation/Feasibility Study. However, we are attaching an addendum to the FSP to provide protocols for drilling and subsurface soil sampling, headspace analysis, and surface water sampling (Attachment A). An addendum to the QAPP summarizing sampling activities, including quality control samples, is enclosed as Attachment B. Please note that Standard Operating Procedures for the laboratory analyses of soil samples are included in the August 1996 QAPP. The analytical data will be validated in accordance with the procedures specified in the August 1996 QAPP.

**Schedule**

The North Stormwater Pipe investigation will be scheduled upon receipt of your approval of the proposed investigation and attached Addenda. We expect that the field portion of the investigation can be scheduled within one week of your approval and the sampling activities will not take more than one day.

We will schedule the Sand Pond sampling concurrently with the first round of the Quarterly Groundwater Sampling. The proposed Quarterly Groundwater Sampling program is outlined in the July 1997 Revised Pre-Design Report (U.S. EPA approval is still pending).

If you have any questions regarding the proposed sampling, please contact me at (630) 691-5000.

Sincerely,

MONTGOMERY WATSON



Walter G. Buettner, P.E.  
Project Manager

Enclosures: Attachment A – Addendum No. 4 to Field Sampling Plan  
Attachment B – Addendum No. 4 to Quality Assurance Project Plan

cc: Rick Lanham – Illinois Environmental Protection Agency  
Jerry Hartwig – Forest Preserve District of DuPage County  
Kostas Dovantzis – Tetra Tech EM, Inc.

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**ATTACHMENT A**

**ADDENDUM TO THE FIELD SAMPLING PLAN**

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**ADDENDUM NO. 4  
FIELD SAMPLING PLAN  
NORTH STORMWATER PIPE SUBSURFACE SOIL INVESTIGATION AND  
SURFACE WATER SAMPLING OF SAND POND**

**FOR THE**

**BLACKWELL LANDFILL  
DUPAGE COUNTY, ILLINOIS**

**Montgomery Watson File No. 1252008**

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**Prepared For:**

**DuPage County Forest Preserve District  
DuPage County, Illinois**

**Prepared By:**

**Montgomery Watson  
2100 Corporate Drive  
Addison, Illinois 60101**

**August 1997**



**MONTGOMERY WATSON**

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## 1.0 INTRODUCTION

A Field Sampling Plan (FSP) was previously prepared as part of the Pre-Design Investigation Work Plan (Montgomery Watson, August 1996). That FSP presented the scope of work, organization, objectives, functional activities, and specific operating procedures associated with the Pre-Design Investigation Activities for the Blackwell Landfill.

Addendum No. 1 to the August 1996 FSP was prepared as part of the Expedited Final Design Report for the Leachate Collection System (LCS) (Montgomery Watson, May 1997), and provided additional sampling details associated with the proposed LCS construction activities.

Addendum No. 2 to the August 1996 FSP provided additional sampling details associated with construction of Cap Repairs.

Addendum No. 3 provided an updated list of proposed groundwater monitoring wells to be included in the quarterly groundwater monitoring program.

This Addendum No. 4 has been prepared to supplement the August 1996 FSP and the August 1990 FSP and provides standard operating procedures required for the North Stormwater Pipe Investigation and the Surface Water Sampling of Sand Pond.

## 2.0 FIELD SAMPLING PLAN

### 2.1 HEADSPACE ANALYSIS

#### Objectives

The objective of the headspace analysis is to field screen soil samples.

#### Equipment

- OVM/data logger Model 580B Photoionization Detector (PID)
- Eight-ounce glass sample jars
- Aluminum foil
- Soil knife/spatula
- Rubber gloves
- Health and Safety Plan
- Statement of Work/Sampling Plan or equivalent

#### Method

Headspace analysis will be conducted in the following manner:

- Fill an eight-ounce glass jar approximately half full with a soil sample.
- Cover mouth of glass jar with aluminum foil.
- Fasten lid cover securely on the glass jar.
- Allow samples to equilibrate to room temperature.
- Insert PID probe into the glass sample jar by pushing the probe through the aluminum foil seal. Do not allow PID probe to touch soil.
- Record peak PID reading.

### 2.2 SOIL BORING AND SAMPLING

#### Objective

The objective of drilling and sampling subsurface soils in the discharge area of the North Stormwater Pipe is to determine the impacts, if any, of stormwater discharge.

#### Personnel and Responsibilities

Boreholes will be drilled by a team of one driller and one to two helpers. Drilling operations will be supervised by a geologist or engineer who will collect soil samples and log the boreholes.



## Equipment

- Health and Safety Plan
- Field boring log forms (Montgomery Watson Standard)
- Daily Drilling Summary
- Unified Soil Classification System summary
- Decon solutions, brushes, buckets
- Statement of Work/Sampling Plan
- Tape measure
- Soil knife/spatula
- Utility knife
- Sampling bottles

## Methods

Soil boring and sampling will be conducted in the following manner:

1. Soil borings will be drilled with a 4¼-inch hollow-stem auger, using a truck-mounted or ATV-mounted drilling rig. Two stratigraphic borings will be drilled to a depth equivalent to the depth of the terminal manhole of the perforated discharge pipe. Continuous split spoon samples will be obtained for the entire borehole.
2. Split spoon sampling will be performed continuously (2-foot intervals) within each borehole. Representative soil samples will be collected in 8-ounce glass jars for headspace analysis. The borehole will be logged by recording visual descriptions of the soil sample and blow counts from driving the spoons.
3. Two additional borings will be drilled within five feet of the stratigraphic borings for the collection of subsurface samples for analytical testing. Only one soil sample (plus appropriate quality assurance samples) will be collected from each soil boring, and it is anticipated that this sample will be collected from a depth equal to, or just greater than, the depth of the perforated discharge pipe. However, if a shallower stratigraphic soil sample shows visible evidence of impacts and has a high headspace reading, the shallower soil sample will be submitted for analysis instead. The collected soil sample will be submitted to First Environmental Laboratories for analysis of TCL-VOCs, TCL-SVOCs, and TAL metals and cyanide using SW-846 methodologies.
4. If refusal is encountered prior to reaching the equivalent depth of the terminal manhole of the perforated discharge pipe, an alternate location will be chosen within ten feet of the original location and another attempt will be made. Each completed boring will be backfilled with bentonite chips and soil cuttings mixture, bentonite slurry, bentonite sand slurry, or hydrated bentonite chips at the discretion of the project geologist or engineer.

Applicable quality assurance procedures for the activities described above are specified in the August 1996 QAPP and Addenda.

Drilling cuttings and excess soils derived from split spoon sampling will be evaluated in the open atmosphere during drilling with an 10.5 eV PID in the field. If PID readings are equal to or exceed five ppm, then these cuttings and soils will be placed on the landfill in an area of future Cap Repair and covered with compacted clay. If PID readings are less than five ppm, then these cuttings and excess soils will be returned to the boreholes.

## **2.3 SURFACE WATER SAMPLING**

### **Objective**

The objective of surface water sampling of Sand Pond is to assess whether the pond is currently being impacted by the Blackwell Landfill.

### **Equipment**

- Health and Safety Plan
- Waders/Hip boots
- Long rubber gloves
- Sampling Bottles
- Statement of work/sampling plan

### **Methods**

The surface water sample will be obtained in the following manner:

1. The sampling technicians will wade out into the pond from a point nearest the landfill until the water is approximately three feet deep.
2. A sufficient time period will be allowed prior to sampling to allow settling of any sediment disturbed by entering the sample area.
3. The capped sampling bottle will be placed approximately one and one-half feet below the surface of the water.
4. The cap will then be removed to allow the sample to be collected.
5. The vial will be capped underwater. Once the cap is securely fastened, the vial will be removed from the water and appropriately marked.
6. A background groundwater sample will be collected from Pine Pond.

7. Surface water samples will be analyzed by First Environmental Laboratories, Inc. using SW-846 methodologies for TCL-VOCs, TCL-SVOCs, and the Target Analyte List (TAL).

Applicable quality assurance procedures for the activities described above are specified in the August 1996 QAPP and Addenda.

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**ATTACHMENT B**

**ADDENDUM TO THE QUALITY ASSURANCE PROJECT PLAN**

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**ADDENDUM NO. 4  
QUALITY ASSURANCE PROJECT PLAN  
NORTH STORMWATER PIPE SUBSURFACE SOIL INVESTIGATION AND  
SURFACE WATER SAMPLING OF SAND POND**

**FOR THE**

**BLACKWELL LANDFILL  
DUPAGE COUNTY, ILLINOIS**

**Montgomery Watson File No. 1252008**

---

**Prepared For:**

**DuPage County Forest Preserve District  
DuPage County, Illinois**

**Prepared By:**

**Montgomery Watson  
2100 Corporate Drive  
Addison, Illinois 60101**

**August 1997**



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## LIST OF ATTACHMENTS

Attachment 1 Operating Manual for Photoionization Detector

## 1.0 INTRODUCTION

A Quality Assurance Project Plan (QAPP) was previously prepared as part of the Pre-Design Investigation Work Plan (Montgomery Watson, August 1996). This QAPP presented the organization, objectives, functional activities, and specific quality assurance (QA) and quality control (QC) activities associated with the Pre-Design Investigation Work Plan for the Blackwell Landfill. The QAPP also described the specific protocols which will be followed for sampling, sample handling and storage, chain of custody, and laboratory and field analyses.

Addendum No. 1 to the August 1996 QAPP was prepared as part of the Expedited Final Design Report for the Leachate Collection System (LCS) (Montgomery Watson, May 1997), and provided additional details associated with the proposed LCS construction.

Addendum No. 2 to the August 1996 QAPP was prepared to provide the additional quality assurance and quality control activities associated with construction of Cap Repairs.

Addendum No. 3 provided an updated list of proposed groundwater monitoring wells to be included in the quarterly groundwater monitoring program.

This Addendum No. 4 has been prepared to supplement the August 1996 and the August 1990 QAPP, and updates tables required for the analysis of soil samples collected during the North Stormwater Pipe Soil Investigation and water samples collected during surface water sampling of Sand Pond.

## **2.0 QUALITY ASSURANCE PROJECT PLAN**

Information presented in the August 1996 QAPP is applicable to the Sand Pond surface water sampling event and the North Stormwater Pipe Soil Investigation, with additional information presented herein.

### **2.1 PROJECT OBJECTIVE AND SCOPE**

The objective of drilling and sampling subsurface soils in the discharge area of the North Stormwater Pipe is to assess if these soils have been impacted by stormwater discharge. The objective of surface water sampling of Sand Pond is to assess if the pond is impacted by the Blackwell Landfill. The Scope of Work is provided in the attached addendum to the Field Sampling Plan (FSP).

### **2.2 PARAMETERS TO BE TESTED AND FREQUENCY**

A summary of sample matrices, analytical parameters, and frequencies of sample collection is provided in Table 1. A summary of sample volume, bottle, preservative, and packaging requirements for the soil samples is provided in Table 2.

### **2.3 DATA QUALITY OBJECTIVES**

Refer to Table 3 for a summary of data generating activities and associated data quality objectives.

### **2.4 PROJECT SCHEDULE**

The Sand Pond surface water sampling event and the North stormwater Pipe Soil Investigation are each scheduled to occur over the course of one day. Analytical results should be received within two weeks. The final report should be completed within three weeks after receiving analytical data.

### **2.5 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA**

The number of duplicate and field blank samples to be collected are listed in Table 1. Sampling procedures are specified in the August 1996 FSP and Addenda. The level of QC effort provided by the laboratory will be equivalent to the level of QC effort specified in Table 3-2 of the August 1996 QAPP and specified in the Standard Operating Procedures included in the August 1996 QAPP.



## **2.6 SAMPLING PROCEDURES**

Sampling and testing procedures for the subsurface soil samples are described in the attached FSP Addendum and the August 1996 QAPP, respectively. Sampling and testing procedures for the surface water samples are described in the attached FSP Addendum and the August 1996 QAPP, respectively. Refer to Table 1 for matrices, parameters, and laboratories performing the analysis.

## **2.7 CALIBRATION PROCEDURES AND FREQUENCY**

The photoionization detector (PID) will be calibrated in accordance with the manufacturer's operating manual (Appendix 1 of the QAPP Addendum).

## **2.8 ANALYTICAL PROCEDURES**

Headspace analysis procedures are provided in the attached FSP Addendum.

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**TABLE 1**  
**Sampling Type and Estimated Sample Numbers**  
**Final Design Blackwell Landfill/DuPage County Forest Preserve District**  
**DuPage County, Illinois**

Matrix	Lab <sup>(1)</sup>	No. of Samples <sup>(2)</sup>	Field Duplicates <sup>(3)</sup>	Field Blank <sup>(4)</sup>	Total No. Samples <sup>(5)</sup>	Laboratory Parameters <sup>(6)</sup>	Field Parameters
Surface Water (7)	First Envir.	2	1	1	4	TCL-VOCs, TCL-SVOCs, TAL	None
Sediment Sampling (7)	First Envir.	3	0	0	3	TCL-VOCs, TCL-SVOCs, TAL	None
Subsurface Soil (discharge area of North Stormwater Pipe)	First Envir.	2	0	0	2	TCL-VOCs, TCL-SVOCs, TAL	Headspace Analysis

General Notes:

1. Lab address and telephone number:  
- First Environmental Laboratories (First Envir.)  
1600 Shore Road  
Naperville, IL 60563 (630) 778-1200
2. A trip blank for TCL VOC analysis will be included with each cooler shipped. Trip blanks are not included in the total number of samples.
3. Field duplicates will be collected at a ratio of one field duplicate for each 10 investigative samples collected.
4. Field blanks will be collected at a ratio of one field blank for each 10 investigative samples collected.
5. Matrix spike/matrix spike duplicates (MS/MSD) will not be collected but will be analyzed and reported in accordance with standard operating procedures and standard laboratory practice.
6. Refer to Table 7-1 of the August 1996 QAPP for method reference. Refer to Table 1-2 for sample volume and preservation requirements (August 1996 QAPP).
7. One surface water and two sediment background samples will be collected from Pine Lake. The sediment background samples will be collected from the east and west end of the lakes.

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**TABLE 2**

**Sample Quantities, Containers, Preservatives, and Packaging Requirements  
North Stormwater Pipe Soil /Sand Pond Surface Water Investigations  
Blackwell Landfill/DuPage County Forest Preserve  
DuPage County, Illinois**

<b>Analysis</b>	<b>Bottles &amp; Jars</b>	<b>Preservation</b>	<b>Holding Time<sup>(1)</sup></b>	<b>Volume</b>	<b>Shipping</b>	<b>Packaging<sup>(2)</sup></b>
<b>Subsurface Soil and Sediment Samples</b>						
TCL VOCs	1 - 4 oz Glass Jar	Iced to 4°C	14 days from sampling date	Fill completely	Same day courier	Vermiculite or bubble wrap
TCL SVOCs,	1 - 4 oz Glass Jar	Iced to 4°C	14 days from sampling date	Fill completely	Same day courier	Vermiculite or bubble wrap
TAL	1 - 4 oz Glass Jar	Iced to 4°C	Cyanide - 14 days Mercury - 28 days all other - 6 months	Fill completely	Same day courier	Vermiculite or bubble wrap

General Notes:

1. Holding time begins at the time the sample is collected.
2. The packaging material should completely cushion the sample bottles - bottom, sides, and top.
3. Refer to the August 1996 QAPP for aqueous samples.

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**TABLE 3**

**Summary of Data Generating Activities and Associated Quality Objectives  
Blackwell Landfill/DuPage County Forest Preserve  
DuPage County, Illinois**

<b>Activity</b>	<b>Description</b>	<b>Intended Data Usages</b>	<b>Parameter<sup>(1)</sup></b>	<b>Number of Samples</b>
Surface Water Sampling	Collect a grab sample of surface water from Sand Pond and a background sample from Pine Lake	Evaluate impacts to surface water in Sand Pond	TCL-VOCs, TCL-SVOCs, TAL	See Table 1
Subsurface Soil Sampling	Collect two soil samples in discharge area of North Stormwater Pipe	Evaluate soil impacts in discharge area of North Storm Water Pipe	Headspace analysis TCL-VOCs, TCL-SVOCs, TAL	See Table 1
Sediment Sampling	Collect a grab sample of sediment from Sand Pond and two background samples, one from the east end of Pine Lake and one from the west end of Pine Lake	Evaluate impacts to sediment in Sand Pond	TCL-VOCs, TCL-SVOCs, TAL	See Table 1

**General Notes:**

1. Refer to Tables 1 and 2 for parameter lists and required detection limits.

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**APPENDIX 1 OF THE QUALITY ASSURANCE PROJECT PLAN**

**OPERATING MANUAL FOR  
PHOTOIONIZATION DETECTOR (PID)**

# OVM/DATALOGGER

MODEL 580B

 *Thermo Environmental Instruments Inc.*

# INSTRUCTION MANUAL

## OVM / DATALOGGER

### MODEL 580B

**TE** *Thermo Environmental Instruments Inc*

8 WEST FORGE PARKWAY • FRANKLIN, MA 02038

(508) 520-0430 • TELEX: 200205 THERO UR

# 580B USER MANUAL

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## INSTRUMENT WARRANTY

**WARRANTY.** Subject to the exceptions stated below, Thermo Environmental Instruments Inc. agrees to correct, either by repair or, at our option, by replacement, any defects in materials or workmanship which develop within one year from the date of surface shipment, parts and labor supplied free of charge and surface transportation costs to be borne by the offeror both ways, provided that the investigation and inspection defects developed under normal and proper use.

The exceptions mentioned above are: (1) All items claimed defective must be returned to Thermo Environmental Instruments Inc., transportation charges collect, and will be shipped prepaid and charged to the customer unless the item is found to be defective and covered by the warranty in which case Thermo Environmental Instruments Inc. will pay all transportation charges; (2) Thermo Environmental Instruments Inc. agrees to extend to the customer whatever warranty is given to Thermo Environmental Instruments Inc. by suppliers of component items purchased by Thermo Environmental Instruments Inc. and incorporated into products sold to the customer; (3) Thermo Environmental Instruments Inc. shall be released from all obligations under this warranty in the event repairs or modifications are made by persons other than its own authorized service personnel, or service personnel from an authorized representative, unless such repair is minor, merely the installation of a new plug-in component; (4) If any model or sample was shown to the Purchaser, such model or sample was shown merely to illustrate the article and not to represent that any article delivered hereunder would conform to the model or sample; and (5) Spare parts are warranted for ninety (90) days.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL, IMPLIED OR STATUTORY. SELLER DOES NOT WARRANT MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, OR MAKE ANY OTHER WARRANTY OR AGREEMENT EXPRESSED OR IMPLIED WITH RESPECT TO ANY ARTICLES COVERED HEREUNDER. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THOSE EXPRESSLY STATED IN THIS CONTRACT.

# SECTION I

## Introduction

The 580B is a portable Organic Vapor Meter (OVM). Which detects and quantitates most organic vapors with a high sensitive photoionization detector (PID). The 580B has an operating range of 0-2000 parts per million (ppm) with a minimum detectable of 0.1 ppm. No support gases are required.

The 580B is controlled by a microprocessor which provides many features that were not previously available. Maximum signal hold, detector linearization, overrange lockout, IBM PC (or compatible) interface, extensive data logging capability and much more. With the many features provided by the 580B leak detection, head space measurements, and field surveys are all easily accomplished. Completely portable, the 580B operates from internal batteries for eight hours in the field.

### 1.1 ABOUT THIS MANUAL

This manual is broken down into eight chapters. The first chapter (this one) provides a general overview of the 580B. Chapter two discusses, in great detail, the extensive facilities of the 580B. The focus of this chapter is on how to use the several switches to access the various facilities. Chapter three explains, in detail, how to perform routine maintenance on the 580B. Chapter four is a technical discussion of calibration and methods for generating standards. Chapter five is a technical discussion of a few applications which illustrate some of the uses of the 580B. Chapter six is a technical discussion of methods for collecting a sample using the 580B. Chapter seven is a discussion of the communication facilities provided by the 580B. Chapter eight contains two flow charts which illustrate the 580B software flow. This chapter is a helpful tool for the new user. Appendix A is a detailed explanation of the 580B communication protocol. This chapter is provided in order to allow a programmer to develop specialized communication software for the 580B. There are several other addendums which contain miscellaneous information about the 580B.

### 1.2 INSTRUMENT OVERVIEW

This section describes various points of interest on the 580B. Each number refers to a number in figure 1.1.

1. **POWER PLUG** - The power plug is used to run the instrument off of its internal batteries. There is a chain attached to the power plug so that it will not be lost.

2. **RS-232 CONNECTOR** - This connector is used for communication with a serial printer or computer. A communication cable provided with the instrument fits into the receptacle.

3. **KEY PAD** - There are seven switches which operate the 580B. The switch marked ON/OFF is used to turn the pump and lamp on and off. The switch marked LIGHT will turn on backlighting for the two line display. The other five switches perform various functions. For a detailed description of the function of each switch see chapter two or the flow charts in chapter eight.

4. **DISPLAY** - The 580B has a two line by sixteen character display.

5. **SHOULDER STRAP** - There is an adjustable shoulder strap for carrying the 580B.

6. **SAMPLE EXIT PORT** - The 580B sample is drawn into the detector by a positive displacement pump and then sent back out through the exit port.

**NOTE** : The photoionization detector is a non destructive detector so the sample may be collected at the exit for further analysis (see chapter six).

7. **PUMP** - The 580B pump draws the sample into the detector.

8. **MOUNTING SCREWS** - There are four screws which hold the 580B top and bottom together. The screws are specially designed so that they do not fall out when they are loosened out of the case top.

9. **DETECTOR** - The photoionization detector is shown with the lamp and high voltage power supply.

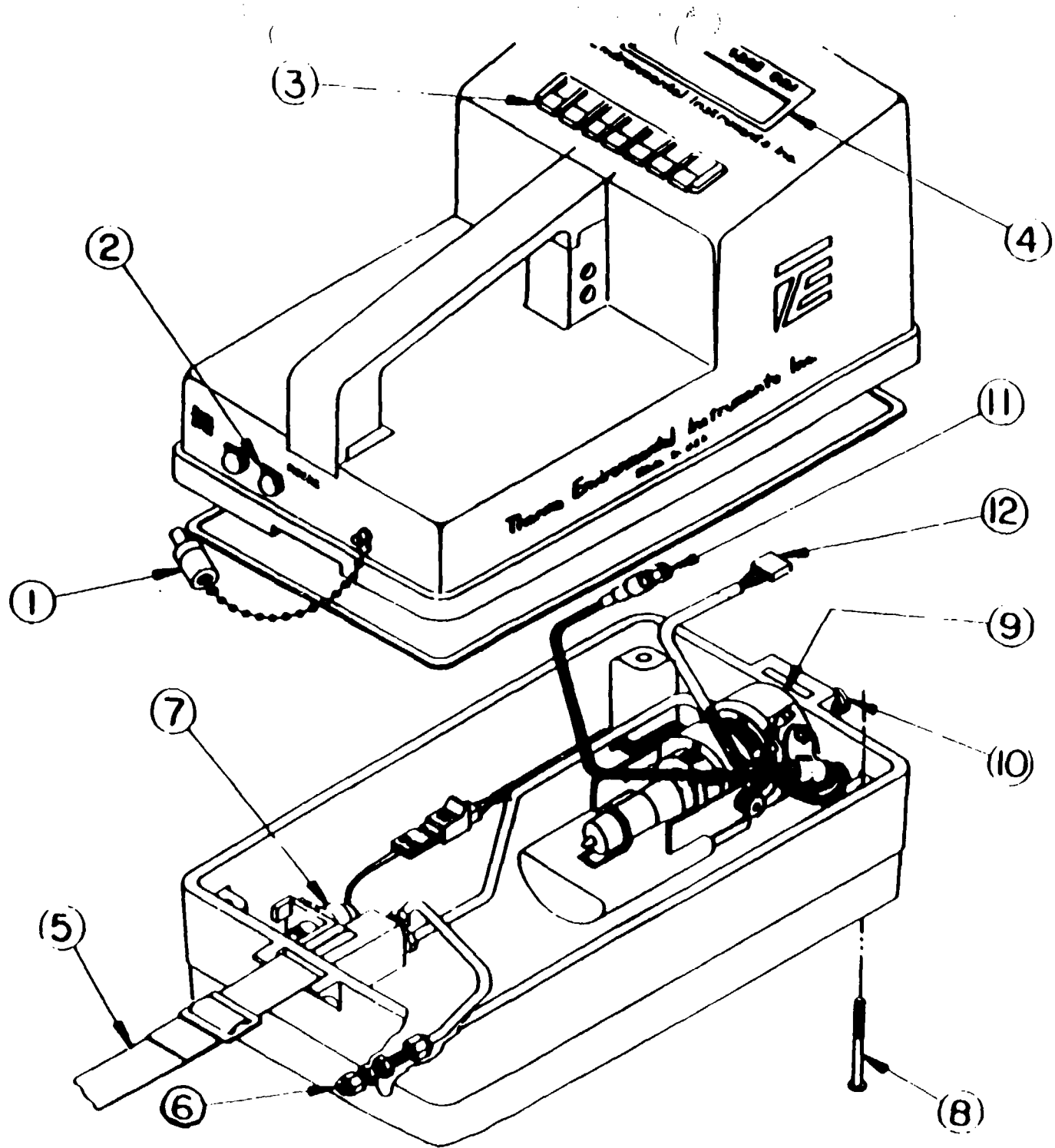


FIGURE 1-1

10. **SAMPLE INLET** - Sample is drawn into the detector through the sample inlet at the front of the 580B.
11. **SIGNAL CABLE** - The PID signal is brought up to the microprocessor, for analysis, via the coaxial signal cable
12. **BASE HARNESS** - The base harness plugs into a connector on the case top.

### 1.3 580B FEATURES

This section provides a brief overview of the various features of the 580B. After reading this section the user should have a good idea of what the instrument can do. Chapters two and three will explain, in detail, how each feature is selected.

**TURNING ON PUMP AND LAMP** - The pump and lamp are turned on by pressing the ON/OFF switch (the instrument power must already be on).

**CALIBRATION** - Calibration of the 580B is extremely important. Chapter two explains how to calibrate the 580B in great detail. Chapter four discusses at length some of the basic theory and methods behind calibration. It is strongly suggested that this chapter be read in order to gain a deeper understanding of usage of the 580B. Chapter three also discusses calibration

**CONCENTRATIONS** - Once the lamp and pump have been turned on the 580B begins to display the concentration of the incoming sample on the bottom line of the display. Normally the top line of the display will be a bar graph (logarithmic on a scale of zero to 2000). The operator may however select the MAX HOLD mode of operation. When in max hold, the top line of the display will show the highest concentration.

**LOGGING** - The 580B provides extensive facilities for logging information. The operator may save a particular reading along with a six digit location code and a date and time stamp. If the 580B is in the MAX HOLD mode when logging is initiated then the max hold value will be logged.

**AUTO LOGGING** - Logging may be performed automatically by using the 580B's auto logging feature. Auto logging is not allowed while in the MAX HOLD mode. When auto logging is selected a LOGGING INTERVAL is selected (anywhere from one second to 99 minutes and 59 seconds). At the end of each logging interval the present concentration will be logged (the location code is automatically incremented each time).

**AVERAGE** - The 580B normally updates the concentration once per second. The operator has the option of setting the averaging time anywhere from one second up to four minutes.

**NOTE** : The bottom line of the display will be blank until the first averaging interval is completed. The top line will however be updated each second.

**RESPONSE FACTOR** - A response factor may be used in order to relate a particular gas to the calibration gas. When computing the concentration the microprocessor multiplies the concentration by the response factor and displays the result. If the response factor is one then the concentration is not changed. Chapter four and five explain some uses of the response factor.

**LAMP SELECTION** - The 580B allows for calibration data to be saved for one 10.6 eV lamp and one 11.8 eV lamp. A lamp serial number may also be entered. This allows lamps to be switched in the field without requiring recalibration.

**ALARM** - An alarm level may be selected. The 580B will sound an audible alarm (the top line will also indicate an alarm) whenever the concentration goes above the selected alarm level.

**ACCESS** - The 580B provides four access levels so that various features may be "locked out." User identification number and instrument number are also provided.

**CLOCK** - The 580B has an internal clock which will run even when the instrument power is cut off.

**COMMUNICATION** - The 580B has a serial communication port for outputting data to a serial printer. Many of the 580B features may be accessed from a remote computer through the serial communication port (there is communication software available which will run on an IBM PC or clone).

**DISPLAY LOGGED DATA** - The logged data may be displayed on the 580B's two line display.

## SECTION 2

### Principle of Operation

#### 2.1 INTRODUCTION

The 580B has seven switches located just below the display. They are labeled:

ON/OFF      MODE/STORE      RESET      LIGHT      ← INC      ← CRSR      SPKR

The ON/OFF switch toggles the lamp and pump power between on and off. The MODE/STORE, RESET, ← INC, ← CRSR and SPKR switches all have various meanings (including none at all) depending upon the mode. The SPKR switch normally is used to toggle the instrument speaker between on and off. Pressing the MODE/STORE switch will cause the 580B to return to the Run mode. Except when the 580B is already in the run mode. In which case it will cause the 580B enter the log mode.

The LIGHT switch is used to illuminate the display.

The 580B has several modes. Some of the modes may have sub modes. The modes and sub modes are tabulated below.

Run mode  
    Concentration meter normal  
    Max hold  
Log mode  
Parameter mode  
    Calibration mode  
Access mode  
Clock mode  
Communication mode

The following sections will describe each mode and how to get to them and through them. It is strongly suggested that this section be carefully read and that the 580B be used along with the manual in order to reinforce the manual.

#### 2.2 RUN AND LOG MODE

##### 2.2.1 POWER FOR LAMP AND PUMP

When the 580B is first turned on (see section 1.3) the display will indicate that the lamp is not lit. Pressing the ON/OFF switch will tell the microprocessor to turn on the lamp and the pump. The microprocessor will send power to the lamp and pump and then "look" to see if the lamp actually lit. If it did not light then the microprocessor will try again. If after fourteen seconds the lamp still will not light then the microprocessor will indicate a lamp out condition.

In the event that the microprocessor is unable to light the lamp, check the seating of the lamp (see section 3.1). If the problem persists call service.

Once the lamp is lit the display will show the PPM (parts per million) on the bottom line. The top line will either be a bar graph or the maximum reading (see section 2.2.2).

To turn the the lamp and pump off simply press the ON/OFF switch.

##### 2.2.2 RUN MODES

The 580B has two run modes. Max Hold and Concentration meter. The run mode is selected in the Parameters section (see section 2.3). In the concentration meter mode the top line of the display will be a bar graph. The bar graph is a logarithmic bar graph over the range of 0 to 2000 PPM. The bar graph is intended as a rough visual indication of the current PPM. The bottom line will indicate the exact PPM.

In the Max Hold mode the top line of the display will indicate the maximum reading. The bottom line of the display will indicate the current PPM. Whenever a new maximum is seen the top line will be updated. The Max Hold reading may be reset by pressing the RESET switch while in the run mode.

### 2.2.3 LOG MODE

The ability to "log" data is one of the 580B's greatest features. Readings may be stored for later analysis. Each reading will have a date and time as well as a location code associated with it. Up to over 700 readings may be stored. Logged data may even be sent to a printer or computer via an RS-232 serial communication port (see section 2.6).

The Log mode is entered from the Run mode by pressing the MODE/STORE switch. When this switch is pressed from the Run mode the display will show:

LOG THIS VALUE?

on the top line and either PPM or MAX PPM on the bottom line depending upon which run mode the 580B is currently in. By pressing the +/INC switch the display will then show:

LOC. CODE 000001

on the top line (the actual location code may not be 000001). The location code may now be entered. By pressing the +/INC switch the number above the cursor may be incremented. By pressing the -/CRSR switch the cursor may be moved to the next digit. The 580B automatically increments the location code each time a data point is logged.

Once the desired location code has been entered pressing the MODE/STORE switch will "log" the data point. This means that the reading displayed on the bottom line along with the location code, the current date and the current time will be stored into the 580B's memory. The 580B will then return to the Run mode.

If for any reason logging is not desired, pressing the RESET switch rather than the MODE/STORE switch will cause the value not to be stored. The 580B will then go back to displaying:

LOG THIS VALUE?

Pressing the mode switch will now return the 580B to the Run mode.

#### 2.2.3.1 AUTO LOGGING MODE

The 580B may be instructed to automatically log data according to a predefined time interval. AUTO LOGGING is selected from within the Parameters section (see section 2.3). At the end of the logging interval (setable from 1 second up to 99 minutes and 59 seconds) the current average ppm value will be logged and the logging interval will be restarted.

NOTE : Auto logging is not allowed with the Max Hold mode.

### 2.2.4 SPEAKER

While the 580B is in the Run mode the speaker may be turned on. The speaker will generate a "clicking" which will increase in speed as the concentration increases. The purpose of the speaker is to give to operator an audible indication of the PPM. The speaker may be turned on or off by pressing the SPKR switch. The speaker rate may also be changed by changing the switches located inside of the side door (see section 1.2). Only one of the four speaker rate switches should be on (in the down position) at any time.

### 2.2.5 LOW BATTERY

The 580B will display a warning when the battery is low. The warning will be a flashing B in the left hand corner of the bottom line of the display when the 580B is in the Run mode. The 580B should be recharged when the low battery warning is activated.

### 2.2.6 OVERRANGE

The 580B will display an overrange warning if the concentration goes above 2000 PPM. The top line of the display will show:

OVERRANGE

Once an overrange condition occurs the instrument will "lock out". This means that the overrange warning will continue to be displayed until the instrument is brought to a "clean" area. A clean area is defined to be an area where the concentration of organic vapors is below 20 PPM. The 580B will continue to indicate PPM on the bottom line during an overrange condition.

### 2.2.7 ALARM

The 580B has an alarm which will sound if the PPM rises above the alarm setting. The alarm setting is entered in the Parameters mode (see section 2.4.3). If the speaker is not activated then the alarm will of course not be heard. Once the PPM drops below the alarm setting the alarm will turn off. The top line of the display will also indicate when there is an alarm condition.

## 2.3 MAIN MENU

By pressing the MODE/STORE switch from the Run mode and then pressing the -/CRSR switch when asked if logging is desired, the 580B will display the main menu:

R/COMM -/PARAM  
+/ACCESS S/CLOCK

The other four operating modes (Communication, Parameters, Access and Clock) may be entered from the Main menu. The operating mode may always be returned to by pressing the MODE/STORE switch.

## 2.4 PARAMETERS MODE

All of the 580B operating parameters are entered in the Parameters mode. The 580B is also calibrated from within the Parameters mode. The Parameters mode may be entered by pressing the -/CRSR switch from the main menu.

There are eight different sections in the parameters mode.

1. Run mode selection
2. Auto Logging selection
3. Average time selection
4. Alarm setting
5. Lamp selection
6. Response factor setting
7. Calibration
8. Free space indication

Pressing the +/INC switch will advance the 580B to the next section. Pressing the -/CRSR will advance the 580B to the previous section. Each section and any of its sub-sections will be described in the following pages. It is important to note that when the 580B is in a sub-section of any of the above sections that the +/INC and -/CRSR switches will have a different meaning. This may seem confusing at first but will become clear after stepping through each section.

### 2.4.1 RUN MODE SELECTION

There are two Run modes. Concentration meter normal and Max Hold (see section 2.2.2). The top line of the display will show:

CONC. METER

the bottom line will show:

"RESET" TO CHG

the bottom line will alternate every two seconds with:

MAX HOLD

if the 580B is in the Max Hold mode. Pressing the RESET switch will cause the 580B to show:

MAX HOLD  
+ = USE/ - = NO

if the + / INC switch is pressed then the Max Hold mode will be selected. If the - CRSR switch is pressed then the Concentration meter normal mode will be selected. In either case the 580B will then return to the previous screen.

#### 2.4.2 AUTO LOGGING SELECTION

The 580B can be configured to automatically log data points. The top line of the display will show:

AUTO LOGGING

The bottom line will alternate between "RESET TO CHG." and "ON" or "OFF". Pressing the RESET switch will cause the 580B to show:

AUTO LOGGING  
+ / ON - / OFF

Pressing the - / CRSR switch will turn auto logging off and return operation to the previous screen. Pressing the + / INC switch will enable auto logging and allow setting of the logging interval. The display will show:

INTERVAL 00:01  
"RESET" WHEN DONE

The + / INC switch will increment the number above the cursor and the - / CRSR switch will move the cursor. The logging interval format is MM:SS (where M is minute and S is second). Pressing the RESET switch will return operation to the first auto logging screen.

#### 2.4.3 AVERAGE TIME SELECTION

The 580B can be configured to display the average PPM from once a second up to once every four minutes. The display will show:

AVERAGE = 0:01  
"RESET" TO CHG

Pressing the RESET switch will cause the 580B to show:

AVERAGE = 0:01  
"RESET" WHEN DONE

The + / INC switch will increment the number above the cursor and the - / CRSR switch will move the cursor. The average time format is M:SS (where M is minutes and S is seconds).

NOTE : The maximum averaging interval is four minutes.

#### 2.4.4 ALARM SETTING

The 580B will display the current alarm setting on the top line of the display. The setting may be changed by simultaneously pressing the RESET switch with either the + / INC switch to increment the digit above the cursor or the - CRSR switch to move the cursor.



## 2.4.5 LAMP SELECTION

The 580B will display:

LAMP

on the top line. The bottom line will alternate every two seconds between:

"RESET" TO CHG

and the currently selected lamp setting and its associated serial number.  
i.e.

11.8eV 000000

By pressing the RESET switch, the 580B will display:

+ / 10eV - / 11eV

on the bottom line. Pressing the + / INC switch will select the 10.0 eV lamp. Pressing the - / CRSR switch will select the 11.8 eV lamp. In either case the 580B will then allow editing of the lamp serial number. The display will show:

SERIAL # 000000  
"RESET" WHEN DONE

The + / INC switch will increment the number above the cursor and the - / CRSR switch will move the cursor. Pressing the RESET switch will return operation to the original lamp screen.

## 2.4.6 RESPONSE FACTOR SETTING

The current Response Factor setting will be displayed on the top line of the display. The Response Factor may be changed by simultaneously pressing the RESET switch with either the + / INC switch to increment the digit above the cursor or the - / CRSR switch to move the cursor.

The response factor is used to equate the response of one organic vapor with that of the calibration gas. The current reading is always multiplied by the response factor in order to obtain the displayed concentration. A response factor of 1.0 will not change the displayed concentration.

## 2.4.7 CALIBRATION

The 580B will display:

"RESET" TO  
CALIBRATE

The calibration mode may be entered by pressing the RESET switch.  
The 580B will display:

RESTORE BACKUP  
+ = YES

The previous calibration information may be restored by pressing the + / INC switch. The 580B will then return to the previous screen. If the backup is not desired, by pressing the - / INC switch the calibration routine will continue. The display will show:

ZERO GAS  
RESET WHEN READY

Once zero gas has been introduced the RESET switch should be pressed. The 580B will then zero the instruments. The 580B will display:

MODEL 580B  
ZEROING

Once the 580B has been zeroed the 580B will display:

SPAN PPM = 0000

The Span gas concentration may now be entered by simultaneously pressing the RESET switch and either the + / INC switch to increment the digit above the cursor or the - / CRSR switch to move the cursor. Once the span gas concentration has been entered the + / INC switch should be pressed.

The 580B will then display:

SPAN GAS  
RESET WHEN READY

Once the span gas has been introduced the RESET switch should be pressed. The 580B will then calibrate the instrument. The 580B will display:

MODEL 580B  
CALIBRATING

Once the 580B has been calibrated the 580B will go back to the beginning and display:

"RESET" TO  
CALIBRATE

If during the zeroing or calibrating of the 580B a steady reading was not seen then the 580B will display:

CAL ERROR  
RESET WHEN READY

Pressing the RESET switch will return the 580B to zeroing or calibrating (depending of course on which it came from).

See section 4.1 for tips on calibrating the 580B.

#### 2.4.8 FREE SPACE INDICATION

This section will give a rough indication of how much room is left for logging data points. The screen will display a bar graph on the top line and the amount of free space on the bottom line. The number indicates the total number of bytes which are available. Each data point takes fifteen bytes. Other bytes may also be needed in order to store other important information. This is why only a rough indication of room may be given.

### 2.5 ACCESS MODE

The Access mode is entered by pressing the + / INC switch from the main menu. The 580B has four access levels, zero through three. Level zero will only allow the operator to log data points and of course to change access levels (only if the access code is known). Level one will also allow the user to change the user identification number. Level two will allow the user complete access to the Parameters mode, and allow viewing of the date and time. Access level three allows complete access.

The access mode has three sections:

1. Access level
2. User identification number
3. Instrument number

Pressing the + / INC switch will advance the 580B to the next section. Pressing the - / CRSR switch will advance the 580B to the previous section.

#### TABLE OF ACCESS LEVELS

ACCESS LEVEL	OPERATIONS ALLOWED
0	Change access level Log data
1	All above operations View time and date View communication format Display logged data Change user I.D.
2	All above operations Change operating Parameters Reset logged data
3	All operations available

#### 2.5.1 ACCESS LEVEL

The screen will display:

ACCESS LEVEL 3  
"RESET" TO CHG

By pressing the RESET switch the 580B will display:

KEY 00003  
"RESET" WHEN DONE

Please note that in both screens the 3 indicates the current access level and may not necessarily be a three.

In order to change the access level the + / INC switch may be pressed to increment the digit above the cursor and the - / CRSR switch may be pressed to move the cursor. The desired access level should be entered in the right most digit. Note that only access levels between zero and three are legal. The remaining four digits are the access code. The access code will be 0000 when the instrument is shipped. The access code should then be entered. Once this is done press the RESET switch. The 580B will then return to the previous screen.

If the access code entered was not the proper access code, or if the access level was not a legal access level then the access level will not be changed.

The last and most important point regarding the access level is how to change the access code. The access code is the four rightmost digits of the instrument number. The instrument number is only viewable (and therefore only changable) while in access level three.

#### 2.5.2 USER IDENTIFICATION NUMBER

The screen will display:

I.D. # 014563977  
"RESET" TO CHG

By pressing the RESET switch the 580B will display:

I.D. # 014563977  
"RESET" WHEN DONE

The user identification number may be changed by pressing the + / INC switch to increment the digit above the cursor and the - / CRSR switch to move the cursor. The user identification number is a nine digit number (just right for fitting a social security number). Once the user identification number has been entered press the RESET switch and the 580B will return to the previous screen.

### 2.5.3 INSTRUMENT NUMBER

The screen will display:

INSTR # 000000  
"RESET" TO CHG

By pressing the RESET switch the 580B will display:

INSTR # 000000  
"RESET" WHEN DONE

The instrument number may be changed by pressing the + / INC switch to increment the digit above the cursor and the - / CRSR switch to move the cursor. Once the instrument number has been entered the RESET switch should be pressed. The 580B will then display the previous screen.

When the instrument number is changed it is very important that the last four digits be remembered. These digits are the access code and therefore will need to be known in order to change the access level.

### 2.6 CLOCK MODE

The Clock mode is entered from the Main menu by pressing the SPKR switch. The screen will display the date and time on the top line. The bottom line will display:

"RESET" TO CHG

By pressing the RESET switch the 580B will display:

"RESET" WHEN DONE

The date and time may be changed by pressing the + / INC switch to increment the number (or in the case of the month the months abbreviation) above the cursor. The - / CRSR switch will move the cursor. Once the proper month has been entered the RESET switch should be pressed. The 580B will return to the previous screen.

The date and time will be maintained even when the instrument is turned off! It is however advisable that the date and time periodically be checked to ensure that it is correct.

### 2.7 COMMUNICATION MODE

The Communication mode is entered from the main menu by pressing the RESET switch. The Communications mode has four sections.

1. Communicate with printer or computer
2. Display logged data
3. Reset logged data
4. Set communication parameters

Pressing the - / CRSR switch will advance the 580B to the next section.

**NOTE :** A detailed discussion of communication protocol is given in appendix A. Further discussion of communication may be found in chapter seven.

### 2.7.1 COMMUNICATE WITH PRINTER OR COMPUTER

The 580B is capable of communicating with a computer or outputting logged data to a printer. The 580B will display:

COMMUNICATE?

"+" = YES

if the computer format is selected or it will display:

OUTPUT TO PRINTER

"+" = YES

if the printer format is selected. In either case pressing the + / INC switch will cause the 580B to try to establish communication. Pressing the - / CRSR switch instead will cause the 580B to advance to the next section.

### 2.7.2 DISPLAY LOGGED DATA

If at least one data point has been logged the 580B will display:

DISP. LOG DATA?

"+" = YES

By pressing the + / INC switch the 580B will display the first data point. The date and time which the data point was logged will be displayed on the top line. The bottom line will alternate between the location code and the PPM. Pressing the + / INC switch will advance to the next logged data point. This will continue until there are no more data points at which time the 580B will display:

NO DATA STORED

The MODE / STORE switch may be pressed to return to the Run mode.

### 2.7.3 RESET LOGGED DATA

The logged data can be erased so that more data points may be logged. The screen will display:

RESET LOG DATA?

"+" = YES

Pressing the + / INC switch will erase all of the logged data points. The 580B will then advance to the next section.

### 2.7.4 COMMUNICATIONS PARAMETERS

The 580B can be configured to communicate with a printer or a computer. The baud rate may also be set for 9600, 4800, 2400, 1200, 900, 600, 300, or 150 baud. The 580B will display the current communication format (computer or printer) on the top line and the current baud rate on the bottom line. Pressing the RESET switch will cause the 580B to display:

COMPUTER FORMAT

+ = USE - = NO

Pressing the + / INC switch will select the computer format and the 580B will advance to the baud rate screen (see below). Pressing the - / CRSR switch will cause the 580B to display:

PRINTER FORMAT

+ = USE - = NO

Pressing the + / INC switch will select the printer format and the 580B will advance to the baud rate screen (see below). Pressing the - / CRSR switch will cause the 580B to display the previous screen.

The baud rate screen will display the currently selected baud rate on the top line. The bottom line will display:

+ = USE - = NO

Pressing the + / INC switch will cause the displayed baud rate to be selected and the 580B to show the selected format on the top line and the baud rate on the bottom line. Pressing the - / CRSR switch instead will cause the next lowest baud rate to be displayed.

## 2.8 BATTERY / CHARGER

The model 580B uses a 1.2 amp hour lead acid (gel cell) battery. There is protection circuitry potted directly on top of the battery. The battery is rechargable with the charger provided with the instrument.

The charger is regulated so that there is no danger of "over charging" the battery. The charger has an LED which indicates when the battery is being charged. The LED's brightness is proportional to the current being delivered into the battery.

## SECTION III

### Routine Maintenance

The routine maintenance of the 580B involves the calibration of the instrument, the cleaning of the lamp window, the maintaining of charge on the battery. The following pages give instructions for routine maintenance. Figure 3.1 illustrates the detector assembly.

#### 3.1 LAMP INSERTION AND REMOVAL

##### 3.1.1 REMOVAL

**NOTE:** The 580B must be off while removing the lamp.

In order to remove the lamp the four screws which hold the case top and bottom together must first be loosened. The case bottom should be placed flat on the table and the top placed on its side next to the bottom.

The high voltage power supply is removed next by loosening the thumb screws on each side and then pulling the power supply towards the rear of the instrument (see figure 3.1). The lamp may now be removed by loosening the lamp nut.

##### 3.1.2 INSERTION

Insertion of the lamp is accomplished by performing the above tasks in the reverse order. The lamp should be placed flat against the o-ring and the lamp nut fastened down in order to create a proper seal. The high voltage power supply should then be inserted and the thumb nuts fastened down. There are three pins protruding from the high voltage power supply which should fit snugly into connectors located beneath the detector. The lamp spring (mounted in the center of the high voltage power supply) should make contact with the lamp ring.

##### 3.1.3 LAMP CLEANING

On occasion the lamp should be removed for cleaning. Cleaning of the lamp is accomplished by cleaning the lens surface of the UV lamp. This is accomplished by using the aluminum oxide scouring powder provided with the 580B.

The procedure for cleaning the lamp is as follows. First place a small amount of aluminum oxide scouring powder on the lens of the UV lamp. Next gently scour this lens with a soft tissue or cloth. Scour the lens in a rotary type motion. After scouring the lens surface gently blow the remaining powder from the lens. Thoroughly wipe the lamp lens with a clean tissue to remove the last traces of cleaning powder. The lamp is now able to be inserted into the detector.

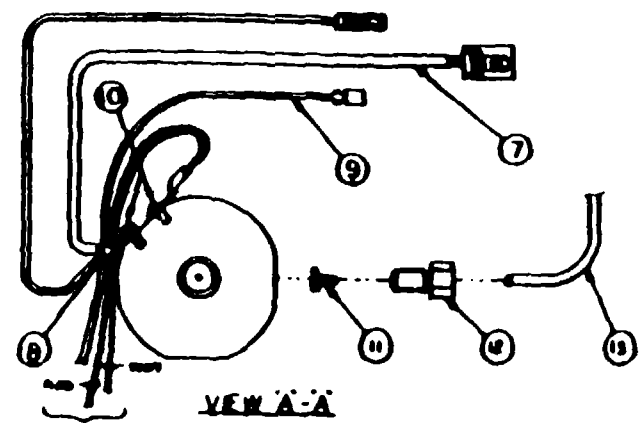
#### 3.2 CALIBRATION

**NOTE:** Chapter four should be read before calibrating the 580B in order to gain a better understanding of the concepts behind calibration of the 580B.

The following is a brief discussion of calibration as it relates to different lamps. One of the parameters in the Parameter mode (see section 2.3) allows selection of lamp setting. The two types of lamps are the 10.0 eV and the 11.8 eV lamp. Whenever a new lamp is used the 580B must be calibrated. This is true even if the new lamp is the same type. For example the new and old lamp are both 10.0 eV. This is due to the fact that each lamp will have a slightly different sensitivity.

It is important to note that the 11.8 eV lamp will in general be less sensitive than the 10.0 eV lamp. This is true despite the higher energy level of the 11.8 eV lamp. The 11.8 eV lamp will however "see" certain gases which the 10.0 eV lamp will not. See table E.1 for a list of common organic vapors and their associated ionization potentials. Any questions regarding the use of the 580B should be directed to Thermo Environmental's Application Laboratory.

The 580B is quite simple to calibrate. A source of "zero air" and "span gas" are all that is needed to calibrate the 580B.



REF SEE  
INTERNAL WIRING  
DIAGRAM  
5803-6003

VIEW A-A

3-2

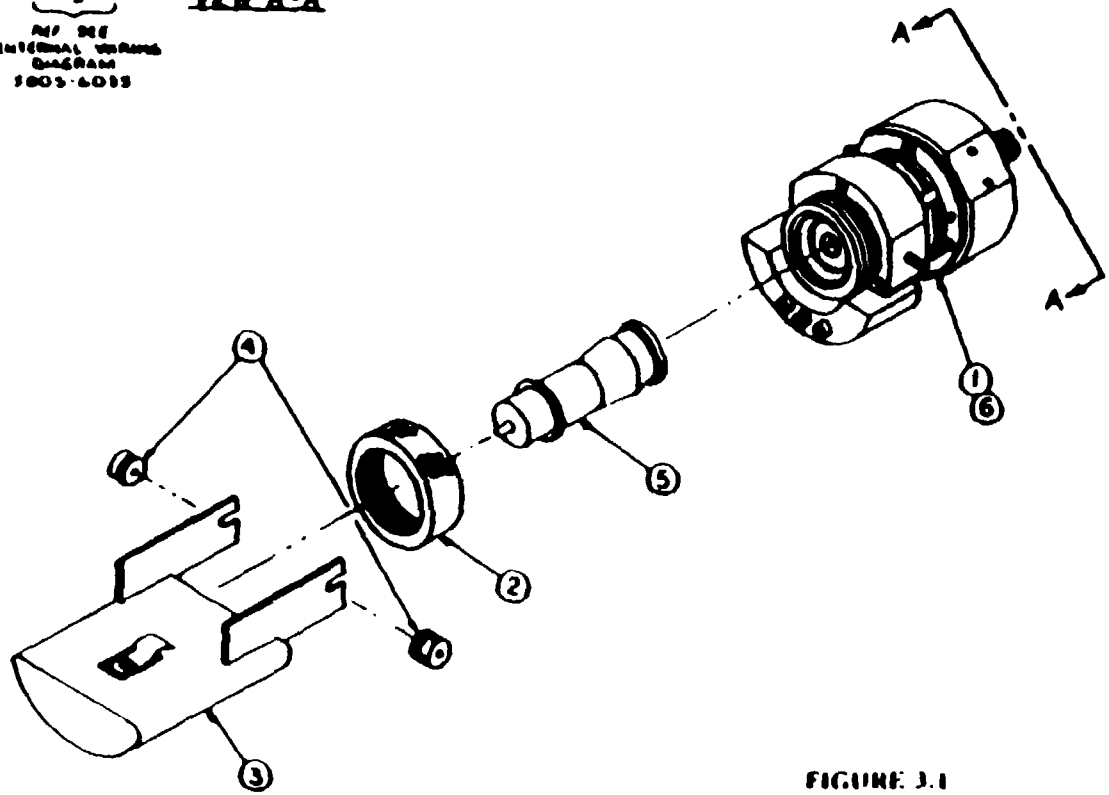


FIGURE 3.1

BILL OF MAT'L			
ITEM	PART NO.	DESCRIPTION	QTY.
1	5803-6003	DETECTOR SUB ASSY.	1
2	5803-2010	NUT-LAMP (13567)	1
3	5803-6010	PWR. SUPPLY ASSY. (13568)	1
4	12002	NUT-KNURLED	2
5	2140-0014	U.V. LAMP 10.0	1
6	5803-6035	DETECTOR WIRING ASSY. (13578)	1
7	5803-6001	BASE HARNESS ASSY.	1
8	4106	STRAIN RELIEF	1
9	5803-6020	SIGNAL CABLE (13566)	1
10	5814	4-40 1/4" BINDER HD. SCREW	2
11	4829	INSERT	1
12	10140	DELRIIN FITTING	1
13	5510	TEFLON-TUBING - 1/8" (APPROX. 8" LG)	1

TITLE		
DETECTOR ASSY.		
DATE	ISSUED	REV
C	580B 6004	



The zero air is introduced to the 580B in order to determine the "background" signal. The concentration of the span gas is then selected. The span gas is finally introduced to the 580B. The instrument makes all of the necessary calculations (including linearization) to arrive at a "calibration constant." When in the Run mode the signal is multiplied by the calibration constant in order to arrive at the current PPM.

$$\text{CALIBRATION CONSTANT} = \frac{\text{SPAN PPM}}{\text{SPAN ZERO SIGNAL}}$$

$$\text{PPM} = (\text{SPAN SIGNAL} - \text{ZERO SIGNAL}) \text{ CALIBRATION CONSTANT}$$

NOTE : The PPM is then multiplied by the RESPONSE FACTOR before being displayed. Chapter four explains the use of response factors when calibrating.

Section 2.4.6 gives a detailed explanation of which buttons to press in order to calibrate the 580B. The flow chart at the back of this manual may also be helpful.

### 3.3 CHARGE

When there is a flashing "B" in the lower left corner of the display (while in the run mode) the battery is low. The battery is recharged by plugging the charger into the RUN/CHARGE plug at the rear of the 580B. The instrument runs while it is charging. The charger has an LED which indicates the amount of current being drawn. The LED gets brighter as more current is drawn. The LED can therefore be used as a rough indication of the charge on the battery.

## SECTION IV

### Calibration

#### 4-1 GENERAL

The Model 580B Organic Vapor Meter is indeed a quantitative instrument and can certainly be used as such. It makes use of the Photoionization Detection System using a lamp with an ionization energy of 10.0 eV which is standard in the Model 580B. Almost all organic materials will be ionized at this energy level. There are some organic materials, such as a few of the freons, methane, ethane and propane that are not ionized and thus will not be detected. The ionization potentials for the various organic materials will simply tell whether the material will be detected by the Photoionization Detector. It does not give any clue as to the sensitivity of that detector for that particular material. Certainly, different organic vapors will have different sensitivities. It is important to understand that the Model 580B does indeed sense most organic vapors and that its response to these different organic vapors will indeed be different.

In this section of the manual, the aspects of calibrating the Model 580B for various vapors will be discussed. In the following section discussing applications, various ways of using the features of the Model 580B will be explained along with the various methods for calibration of the 580B. There will also be applications of the Model 580B in specific instances where the organic vapors or the mixtures of organic vapors are completely unknown. The 580B can be an extremely useful tool, even in areas such as those.

#### FACTORY CALIBRATION OF THE MODEL 580B

To complete testing and operation in the checkout area, each Model 580B has been calibrated and linearity checked at the factory. The particular gas chosen for this calibration is isobutylene. The Model 580B has good response for isobutylene. Isobutylene standards prepared in air are relatively stable with time, undergoing no serious adsorption or reaction problems.

#### 4-2 METHODS OF GENERATING CONCENTRATIONS OF VARIOUS MATERIALS IN AIR.

This section is not intended to be exhaustive as far as the preparation of gas and vapor standards in air are concerned. Only those methods that have been found most practical for the calibration of the 580B are discussed here. There are basically two types of standards. Static standards in which a known volume of the gas or vapor is mixed with a known volume of air and the concentration of the gas or vapor in air calculated from knowing these volumes. The second method used is what is called a dynamic standard. Dynamic standard preparation involves mixing gases or vapors with air under a flowing condition whereby the flow rate of both gases are known prior to their mixing. The concentration then is calculated from flow rates.

Certainly commercially available standard cylinders of gaseous materials in air offer the most convenient method of calibration. However, these are static standards. Standards prepared in this fashion in air for vapors of various organic liquids show concentration reduction with time due to adsorption problems. In general, gases when mixed with air will maintain their concentrations with time since adsorption is generally not a problem. However, some gases are sufficiently reactive that chemical reaction of the gas will cause a reduction of it in air. These precautions must be observed when using commercially prepared standards for calibration of the Model 580B. It is for this reason that isobutylene in air was chosen as a reference standard for factory calibration. Static standards can be prepared in a laboratory and in general are reasonable ways of calibrating the Model 580B. However, it is important that these standards be used shortly after their preparation to reduce the significance of any adsorption problems. Static standards prepared for calibration of the Model 580B are best prepared in collapsible plastic bags. This is opposed to a fixed volume container. The sampling rate of the 580B, which is 500 ml/min, requires an appreciable amount of sample. Even one minute's sampling out of a fixed container will remove 500 ml/min from it. This should not significantly reduce the pressure inside the container. Thus, the collapsible bag provides the best means as opposed to a fixed volume. A 5 gallon polyethylene bag is a convenient size to use for the preparation of static standard.

A tube is inserted into the opened end of the bag and the bag opening then sealed around the tube. The tube should have a cutoff valve or some means of closing the volume of the bag. The volume of air introduced into the bag must be measured. This is most conveniently measured by a wet test meter. However, a source of air flowing through a flow meter can be used if the flow can be held constant, then time is a measure of the volume of the air placed into the bag. All air is expelled from

the bag by completely collapsing it prior to connection to the source of air. It can then be connected to a wet test meter or flow meter via a short length of rubber tubing hooked to the plastic tube of the bag. The air flow is started into the bag at a rate of approximately 5 l/min. A total of 10 liters is a convenient volume for a 5 gallon bag. This would mean approximately 2 minutes for filling the bag.

For gaseous samples, the trace organic will be added via a glass hypodermic syringe. The 1 cc Tuberculin syringe is a convenient size. For an isobutylene standard, the 1 cc syringe is flushed with pure isobutylene and then filled to the 1 cc mark. While the air is flowing into the plastic bag, the short piece of rubber tubing is pierced by the needle from the 1 cc syringe and the plunger slowly depressed such that the 1 cc of isobutylene is added to the air flowing into the plastic bag. When 10 liters of air have been added to the plastic bag, the flow is immediately stopped and the valve on the tube or the closing clamp is applied to contain the air and isobutylene within the plastic bag. It is best at this stage of the procedure not to rely solely on the diffusion of isobutylene to form a uniform mixture inside the plastic bag. Slight kneading of the plastic bag will hasten the mixing of the isobutylene in air. The plastic tube from the bag is then connected to the probe on the Model 580B via a short length of rubber tubing and the valve on the plastic tube immediately opened. The Model 580B withdraws a sample from the bag at the sampling rate of 500 ml/min. Thus, 10 liters of sample in the bag will provide approximately 20 minutes. Certainly the calibration of the 580B can be accomplished in a shorter period of time. The concentration of isobutylene in ppm by volume will be equal to the sample size, which was 1 cc, divided by the volume of the bag in liters, which would be 10 liters, times 1000. In this particular instance, the concentration would be:

$$\text{Conc (ppm by Vol)} = \frac{1 \text{ cc Isobutylene} \times 1000}{10 \text{ L Air}} = 100 \text{ ppm}$$

For organic materials, which are normally liquids at room temperature, the procedure is essentially the same except that an extremely small liquid sample is injected into the flowing air stream rather than the gas sample. This technique works well only for relatively volatile organic materials. The flowing air stream must vaporize all of the material or the calculation will be off. If the material is not rapidly volatile in that flowing air stream, the liquid should be injected through the surface of the plastic bag. Immediately after withdrawing the needle, the hole in the plastic bag should be covered with a piece of plastic tape.

Again significant kneading of the bag will hasten the evaporation of the sample and mixing of the vapor into the air to provide homogeneous samples. The introduction of this sample into the 580B is the same as before. The calculation of the concentration of the vapor in air is a two-step procedure whereby the small volume of liquid injected into the air stream of into the plastic bag is converted to a volume of vapor. This volume of vapor is then used in the same manner as the volume of gas in the case of isobutylene. The following equations apply:

$$\text{Volume Vapor (ul)} = \frac{\text{Liquid Volume (ul)} \times \text{Liquid Density} \times 24.45}{\text{Molecular Weight}}$$

The above equation gives the vapor volume at atmospheric pressure (760 torr) and 25 C (77 F).

$$\text{Then: } \text{Concentration (ppm by Vol)} = \frac{\text{Vapor Volume (ul)} \times 1000}{\text{Air Volume (lit...)}}$$

The following is a sample calculation for benzene.

$$\text{Liquid Volume} = 2 \text{ ul}$$

$$\text{Benzene Density} = 0.879 \text{ g/cc}$$

$$\text{Molecular Weight Benzene} = 78.1$$

$$\text{Air Volume} = 10 \text{ liters}$$

$$\text{Vapor Volume} = \frac{2 \times 0.879 \times 24.45}{78.1} = 0.55 \text{ ul Benzene Vapor}$$

$$\text{Conc} = \frac{0.55 \times 1000}{10} = 55 \text{ ppm (vol)}$$

The syringe used for the measurement of liquids in this particular instance is a small volume-type such as those manufactured by the Hamilton Company. A convenient size syringe is the 10 microliter volume.

Dynamic standards can be prepared of both gases and vapors by using the techniques of either permeation tubes for gases or diffusion tubes for vapors. These permeation or diffusion devices supply a very small flow of either the gas or vapor. This is mixed with a known flow rate of air providing a flowing stream that has a known amount of either gas or vapor in the air stream. These are probably the most reliable and accurate standards available for low level concentration of gases and vapors in air. However, the techniques require some additional instrumentation in order to implement the use of these devices. The reader is referred to Thermo Environmental's applications notebook for the use of these techniques in the dynamic generation of standards.

## SECTION V

### Applications

#### 5-1 GENERAL

This section discusses six applications which were done on the old model 580. These applications are discussed as they relate to the model 580B. The following applications of the Model 580B are given to show some different uses and means of calibration of the Model 580B in various practical applications. It is certainly not intended to be an exhaustive list of the uses of the Model 580B. In each situation, the stress is placed on the means of calibration and the interpretation of the readout of the Model 580B. Since the Photoionization Detector responds to virtually all organic materials and since its response varies for the different organic materials, questions can certainly arise as to just how the numbers presented on the digital display relate to anything meaningful. These applications will hopefully illustrate several ways in which these numbers can be quantitative and also illustrate uses of the 580B where accurate quantitation may be impossible.

#### 5-2 VINYL CHLORIDE MONOMER IN REACTION VESSELS.

This particular application involved measuring the vinyl chloride content in vinyl chloride polymerization vessels following the polymerization reaction and the removal of the polymer slurry. Any residual vinyl chloride left in the reaction vessel has to be flushed and scrubbed prior to the opening of the vessel. The vinyl chloride content must be below a certain prescribed level prior to this opening. The reaction vessel is flushed with nitrogen to remove the vinyl chloride from the vessel and purge it through the filter media which remove the vinyl chloride from the nitrogen stream for recovery. During this particular operation, it is known that vinyl chloride monomer comprises significantly more than 90% of the entire organic material. In this instance, if the Model 580B is calibrated for vinyl chloride measurement, indeed the readout will be virtually the true vinyl chloride concentration inside the reactor vessel. The nitrogen exit stream prior to the vinyl chloride recovery was the point used for the analysis.

Since the plant was a considerable distance from the laboratory and since the study would require a significant period of time encompassing several weeks, it was decided to calibrate the Model 580B with the isobutylene reference standard and determine a response factor setting for a vinyl chloride standard in the laboratory. With the response factor set at 1.0, the instrument was calibrated with isobutylene. The Model 580B was then presented with a known concentration of vinyl chloride monomer in nitrogen. The response factor for the vinyl chloride was then set in order for the Model 580B to read the correct concentration of vinyl chloride in the nitrogen. Static standards of vinyl chloride are very definitely not stable with time due to the reaction of the vinyl chloride with itself. Thus, standards need to be prepared fresh each time vinyl chloride is to be used to calibrate an instrument. Since bag preparation, which was the technique used for this laboratory calibration of the 580B, would have been impractical at the plant; the use of a stable reference standard of isobutylene was chosen. Thus, at the plant site, the Model 580B could be calibrated using the isobutylene standard from a cylinder. This of course, greatly simplified the plant use of the Model 580B. This relationship to a reference standard reduces the time and equipment required at the plant such that the survey of all of the reactor vessels was completed in a short period of time with the items established for the nitrogen flush of the reactor vessels prior to opening the reactor vessels.

#### 5-3 MONITORING ISOLATED PLANT AREAS FOR TOLUENE AND METHYL ISOBUTYL KETONE.

Two areas of an extensive plant operation were required to be monitored for the levels of methyl isobutyl ketone and toluene. Both of these areas were relatively isolated. In one area, methyl isobutyl ketone was the only solvent to which the atmosphere was exposed other than the potential leaks that might occur in process equipment in that same area. There were no other known solvents in use in that area and the ventilating system in effect isolated this area from other areas in the plant. In the second area, toluene had just very recently been substituted as a solvent in place of benzene due to the lower TLV for benzene. Average workplace levels were therefore needed for the toluene concentration in this work area. Again, toluene was the only solvent in this area and there was no other process equipment in the immediate area for even possible leak problems.

Notice that in both of these areas in the plant, it is certainly known from the processes occurring in that area and its relative isolation from the other areas in the plant, exactly which organic vapors will be by far the predominant vapors in the workplace.

air. In many instances, by simply knowing the processes involved and the chemicals in use in those processes, the qualitative aspects of the environment can indeed be established without the use of instrumentation. This is one of the most overlooked aspects in establishing what organic vapors are present in the environment. It simply involves determining what are the possible organic vapors that can be present. In general, this narrows it to several and in many cases, a single organic vapor.

In these cases, the Model 580B can be calibrated specifically for these materials and will provide quantitative data on the levels of these materials in the workplace environment. In this particular instance, even though the laboratory to be used for the calibration of the Model 580B was at the plant site, it was desired to use a single 580B to monitor both work areas sequentially and several times throughout the course of a single day. This was to be done over a period of time to establish the variations of both methyl isobutyl ketone and the toluene in these work areas. In this particular instance, changing the response factor setting can avoid considerable calibration changes, as one moves from determining concentrations of methyl isobutyl ketone to the area where one is measuring the concentrations of the toluene vapor.

For calibration, the Model 580B response factor was set at 1.0 and the instrument spanned properly using a known reference standard of isobutylene. The Model 580B was then presented with a flowing air stream containing toluene vapor as generated in the Thermo Electron Model 360 using a toluene diffusion tube. The response factor was then adjusted so that the readout of the Model 580B corresponded to the toluene concentration in this standard.

The Model 580B was then presented with a flowing air stream containing methyl isobutyl ketone. This also was generated via a diffusion tube in the Model 360 Standards Generator. Once again, the response factor was adjusted so that the digital display gave the correct reading for the concentration for the methyl isobutyl ketone presented to the instrument.

With the instrument then calibrated with the reference isobutylene standard and knowing the proper settings of the response factors for methyl isobutyl ketone and toluene, the Model 580B was then ready for its plant survey. The area containing the toluene was monitored for a period of time with the toluene levels as noted by the 580B being recorded. The response factor was set for this toluene reading. The instrument was then moved directly to the methyl isobutyl ketone area and the response factor adjusted to read methyl isobutyl ketone. The 580B was then able to read directly the methyl isobutyl ketone concentration in the second area. There was the possibility of leaks in process equipment in this particular area. The area in general was surveyed. If significant changes in the reading of the 580B were observed, the 580B was used as a leak sourcing instrument as described in a later section. In this fashion, it could be determined if some of the varying concentrations in this area were indeed coming from a leak in the process equipment. During the survey of this particular area, no leaks from process equipment were observed, therefore, the readings obtained on the 580B could indeed be considered the methyl isobutyl ketone concentration in this particular area.

Throughout the survey of these two workplaces, the 580B could move back and forth rapidly due to its portability and could be, in effect, recalibrated for each of the two different vapors by the mere setting of the response factor.

#### 5-4 PETROLEUM ETHER VAPORS IN WORKSPACE AIR.

A given workplace was using petroleum ether as a paint solvent and for cleaning purposes. It was desired to quantify the amount of petroleum ether in the air being recirculated in this particular area. Petroleum ether is a distillation fraction from crude oil. Its boiling point is slightly lower than the boiling point of gasoline. This means that petroleum ether is not a single chemical entity, but a multitude of hydrocarbons in a certain boiling range fraction. Reasonable quantitative data can be obtained here without knowing the exact chemical composition of each hydrocarbon that composes petroleum ether. For this purpose, the Model 580B can be used to measure these vapors. The 580B is initially calibrated with the response factor set at 1.0 using a reference standard of isobutylene.

The 580B is calibrated on isobutylene. Then a bag sample is prepared, as detailed above, for the quantitation of the instrument to measure the petroleum ether. In this particular instance, the petroleum ether is injected into the bag in the same fashion that liquid samples are injected. The calculation, however, has to change slightly because the ppm on a volume basis cannot be calculated without knowing the exact chemical composition of the petroleum ether. However, in a situation such as this, one can still quantitate it on a weight basis of the solvent in air. The equations below show this calculation.

$$\text{Weight Vapor (mg)} = \text{Liquid Volume (uL)} \times \text{Density g/mL}$$

$$\text{Conc (mg/m}^3\text{)} = \frac{\text{Weight Vapor (mg} \times 1000\text{)}}{\text{Air Volume (liters)}}$$

For Petroleum Ether In This Example:

$$\text{Liquid Volume} = 3 \text{ uL}$$

$$\text{Petroleum Ether Density} = 0.66 \text{ g/mL}$$

$$\text{Air Volume} = 10 \text{ liters}$$

$$\text{Vapor Weight} = 3 \text{ uL} \times 0.66 \text{ g/mL} = 1.98 \text{ mg}$$

$$\text{Conc} = \frac{1.98 \times 1000}{10} = 198 \text{ mg/m}^3$$

This sample in the bag is then presented to the Model 580B and the response factor adjusted so that the digital readout on the front panel provides the proper reading in mg/m<sup>3</sup>. The setting of the response factor that is needed for this reading is noted. The Model 580B can now be used to monitor reasonably quantitatively the petroleum ether in the workplace environment. Any further calibration of the instrument can be done using the reference standard of isobutylene. This is a reasonably accurate way of giving quantitative information on the amount of solvent in air even though the results are not reported in ppm on a volume basis.

This technique can be used in general when the solvents are a mixture of materials which in general will probably be petroleum distillation fractions. It would certainly also be used in the case of gasoline vapors in air. Notice from the equations used versus the equations for determining the ppm concentration in bag samples for pure liquids, the only real thing missing is the molecular weight of the material. It may be possible to assume an average molecular weight of the solvent mixture and actually report a ppm by volume basis.

## 5-5 LEAK SOURCING

In this particular instance, the Model 580B is to be used for determining the presence, or absence of leaks in a chemical process plant. The Model 580B is uniquely adapted to this particular operation due to its light weight. In this particular instance, it is not necessary to accurately attempt to quantitate the readings from the Model 580B. It will be used simply to determine presence of leaks and to locate these leaks.

The Model 580B is simply calibrated against a reference standard of isobutylene as normal. No further calibration is used. It is not necessary to know the particular chemicals flowing in the different pipes or what they are in the various reaction chambers. It is only necessary to know that these materials will have some response on the Photoionization Detector. That is, that their ionization potentials are below the energy of the lamp. The standard probe of the Model 580B, with the 580B fully operational, is then simply moved along the various pipes and reactor vessels in the chemical process.

All seals are traced clear around the seal with the end of the probe. As one approaches a leak, the concentration of the organic materials in the air being sampled by the Model 580B will increase significantly. The point of maximum reading will indicate the point of the leaks. As one moves further away from the leak, the concentration of the organics in air will certainly decrease. In this very rapid fashion, the presence of leaks can be detected and their source fairly accurately pinpointed so that the leak can be repaired.

In many instances, it is not necessarily the workplace hazards of these leaks that is important, but the economics of the chemical process itself. In this instance, as in many instances, the exact composition of the organic materials being measured is really unimportant to the successful use of the 580B in a specific application. Also the exact numbers that are displayed on the digital readout of the 580B are unimportant. It is only relative magnitudes that are important in this instance.

## 5-6 AFTERBURNER EFFICIENCY

In a particular coating process, the material, after it has been coated, is passed into a dryer where the solvents of the coating are removed. These solvents are then vented into a stack. To reduce the hydrocarbon emission from this plant, an afterburner had been installed to combust the organic solvents from the coating prior to release to the atmosphere. It is important to determine the efficiency of this afterburner and to follow the efficiency of the afterburner to avoid dumping excess solvent into the atmosphere and, thus, become subject to pollution fines.

The Model 580B is ideally suited to this type of operation. Again, it will be unnecessary to know the exact chemical composition of the coating solvent. The Model 580B is simply standardized against the reference standard isobutylene in the usual fashion. The Model 580B is then connected to sample the stack gas in the dryer prior to the afterburner, noting the steady state number displayed on the digital panel meter. The 580B is then connected to the exhaust gases from the stack following the afterburner. Again, the steady state number, as displayed on the Model 580B, is noted.

The reading prior to the burner minus the reading after the burner divided by the reading prior to the burner times 100 gives efficiency of the afterburner in the stack. This number is quite accurate, even though the Model 580B was not calibrated specifically for the solvents or solvent mixture used in this particular coating operation. The individual readings before and after the afterburner may not have the exact quantitative relationship to the actual amount of material, but their ratio will be accurate since basically the same chemical or mixture of chemicals is being measured before and after the afterburner.

## 5-7 SAMPLE COLLECTION OF UNKNOWN ENVIRONMENTS

The Model 580B can also be used in areas where organics are known to be present, but perhaps the exact composition of the environment is not known. This may be due to several solvents being in the same general workplace or various separate processes occurring in that same workplace, all of which could and possibly are admitting organic vapors. In plant areas such as these, the Model 580B can still be extremely useful.

The 580B is calibrated against a reference standard of isobutylene, as mentioned above. The 580B is then used as a survey tool throughout the entire plant area. The readings are logged, especially changes in these readings. The exact numbers displayed will not, in general, be a quantitative measure of the ppm of the organic vapor since it is impossible to know what organic chemical or mixture of chemicals should be used for the calibration. When high readings are obtained on the Model 580B, an evacuated sample bag can be connected to the rear of the 580B at the sample exhaust port. This bag could be virtually identical to the type of bag used for standards preparation. The Model 580B is sampling the atmosphere at the rate of 500 mL/min. The detection system of Photoionization is a nondestructive system such that the sample that is exiting the Model 580B is indeed the same material that is giving the readings on the 580B. When the 580B is seeing high readings, this is the time the bag is connected to the rear for sample collection. The bag, if the same type is used for sample preparation, can hold approximately 10 liters of air sample; which would permit a sampling time of 20 minutes. This bag sample can then be closed on removal from the 580B and transported to a laboratory for subsequent analysis to identify the individual chemical compounds present in the sample causing the high readings and to ascertain if the workplace environment is harmful at those high readings.

The use of the Model 580B coupled with the bag collection ensures that the sample that is returned to the laboratory for analysis is a sample containing the desired organic vapors. This is assured because the bag collection is used only when the Model 580B is detecting high levels of organic vapor in the environment. This is an instance of the use of the Model 580B when the type of organic vapors are not known and it is desired to know them. The 580B has a very useful function even in these areas. It should be noted that a charcoal tube could be connected to the rear of the 580B as well as an evacuated plastic bag. The charcoal tube will pass the bulk of the sample, which is air, and adsorb the organic vapors. This charcoal tube can be returned to the lab for subsequent analysis for both a qualitative identification of the materials present as well as a quantitative measure of their levels.



## SECTION VI

### Collection Techniques

#### 6-1 GENERAL

As mentioned in the Application Section, it is possible to use the 580B in completely unknown areas as far as the organic vapors present are concerned and still obtain meaningful data. One of the techniques described here is the use of the 580B as a means of collecting the representative samples for further identification in the laboratory regarding the specific organics that may be present in addition to their concentrations.

Two techniques were mentioned in the section under the heading "Sample Collection of Unknown Environments". One of these techniques involves the use of a bag for collection and the other involves the use of charcoal tubes as a means of trapping organic vapors. In this section, each of these techniques will be explored in further depth as to the proper way of using the 580B to collect the samples for subsequent analysis. These collection techniques are quite useful when one is using the Model 580B simply as a survey instrument. When readings on the 580B become quite high in certain areas it is impossible to determine the exact source of the high readings to perhaps pinpoint the specific organic chemical giving rise to the reading. One may very well want to identify what the chemical or chemical mixture is that is providing the high reading. This will have to be done with instrumentation significantly more sophisticated than the Model 580B; namely, an instrument that can provide specificity as well as qualitative identification. A Gas Chromatograph is such an instrument.

If it is desired to collect some of the air to send to a laboratory for further analysis, one needs to be sure that the proper samples are taken at the proper time. This means simply that one needs to be assured that the sample sent to the laboratory is indeed a sample that has a high concentration of organic vapor present in the sample. The 580B is used to indicate the presence of the high level organic vapors. The sample then is gathered at the exit port of the 580B when the 580B is reading high values. This assures that the sample sent to the laboratory does indeed have the high level vapors present in it. This generally simplifies the sampling technique of the environment and reduces the number of samples and, therefore, the expense needed to accurately identify the organics present and to quantitate them in a laboratory.

Two design features of the Model 580B make this type of operation possible. The first is that the detection system used in the Model 580B is the Photoionization Detector which is basically a nondestructive detector. Thus, the instrument is able to sense the organic vapor using the detector and virtually the same concentration of the same materials exits the detector as entered it. This does make it possible for the collection of the exact sample contributing to the high readings.

The second feature of the 580B that allows this sample collection is that a positive displacement pumping system is used to draw the sample into the Model 580B. It is a very simple procedure then to attach to the exit of this positive displacement pump and trap the sample exiting the 580B after it has passed through the detector.

#### 6-2 BAG SAMPLE COLLECTION.

One of the most convenient ways to sample the environmental air is to simply trap the entire air sample in a collection bag. As discussed before, the bags used for the calibration of the Model 580B, as discussed under the Calibration Section, can certainly be used for collection of the air samples. There are several precautions that must be mentioned immediately relative to the use of bag sample collection. When a bag has been filled with air that has organic vapor in the air sample, the organic vapor molecules will adsorb onto the inside surface of the bag. This adsorption will begin immediately on introduction of the air into the bag. It will continue to progress with time until the vapor molecules adsorb onto the wall of the bag are in equilibrium with the vapor molecules in the air. This equilibrium depends very strongly on the bag material and the chemical entity of the vapor itself. The ambient temperature also has some effect.

As mentioned under the Calibration Procedure, when one is preparing a known vapor concentration in a bag, the bag should be analyzed very rapidly after its preparation to ensure proper calibration of the instrument. The technique here is to use the standard prepared in this fashion as soon as possible such that the adsorption that has occurred is an absolute minimum amount. This adsorption becomes a bit more serious problem in using bags for sample collection. The first problem is simply when one is reusing the bag, one has to be sure that the sample contained in the bag previously has been completely desorbed from the wall. This, in general, can be checked by using clean air to fill a bag allowing the bag to set for a short period of

time, about 1 hour, and then analyzing the air in the bag. If on using the 580 to analyze this air, it shows measureable organics, then the air in the bag should be dumped and new air introduced and allowed to set for the same period of time. There will be a reduction of organic vapor on the second go-around. If it is still too high, this procedure is repeated until the bag shows virtually no organic vapor. The bag can be evacuated and reused.

The other problem associated with adsorption and sample collection is that the sample that is collected in the bag must be analyzed as soon as possible after collection if one is going to determine quantitatively the amount of organic vapor in that bag sample. The longer the sample stays in contact with the bag, the greater will be the adsorption of the organic vapors on the surface of the bag and, therefore, the lower the concentration of the organic vapors in the air sample.

If one is interested here in only doing a qualitative analysis of the organic vapors, that is identify what vapors are present in the air sample, the bag certainly is a convenient way of taking the sample. If one in addition to getting the qualitative analysis desires to quantitate one or more of the specific organic vapors in the sample, the bag sample should be analyzed within an hour of taking this sample. If the bag sample cannot be analyzed this soon, it is recommended that one use the charcoal tube technique explained in the next section.

There are two considerations to be given relative to the size of the bag and, therefore, the size of the sample taken. The first consideration is the amount of sample needed by the laboratory for its analysis. If the analysis is to be done by gas chromatography directly on the air sample, in general only 1 to 5 mL of sample would be required for the analysis. Therefore, this does not become a major consideration here. If, however, other analytical techniques were to be used that would require significantly higher volumes of sample, this should be taken into account.

The other consideration is the sampling time. The Model 580B samples at the rate at which the bag attached to the exit port of the 580B will be filled. If the bag can conveniently hold 10 liters of air, this means that the sampling time can be up to 20 minutes. In general, collection techniques using the Model 580B are not intended to supply a four or eight hour integrated sample. They are used simply to help identify the materials contributing to a high concentration and possibly the analysis of individual toxic organic vapors in that particular air sample. Thus, a 20 minute limitation on sampling time should not be too severe. Certainly larger bags could be used on the exit of the 580B, allowing up to several hours of sampling time should this be desired. The difficulty then becomes that the bags are quite large and physically become difficult to manipulate. It was recommended back in the Calibration Section that perhaps a 10 liter bag would certainly be the convenient bag for the calibration of the 580B. It would appear to be also a convenient bag for collection of the samples. For this purpose, a bag that has no adsorbed vapors on the interior surface is evacuated and closed to the atmosphere. Several of these bags could be carried in a very small container. When the Model 580B is reading high values, and it is impossible to determine the source of the high values, then a bag can be connected to the exit port of the 580B and immediately opened to accept the sample exiting the 580B. The bag is kept connected to this exit as long as the 580B is giving high readings or until the bag has reached its volume capacity. At this point, the bag is removed from the exit port of the 580B, immediately closed, and returned to the laboratory for analysis.

### 6-3 COLLECTION USING CHARCOAL TUBES

A technique very common in industrial hygiene-type analysis is to use a small charcoal tube as a collection device. An air sample is pulled through the charcoal tube at a known flow rate for a known period of time. This flow rate and time determine the total volume of air or total sample size. The organic vapors in the air are adsorbed on the charcoal in the tube. These vapors are then desorbed from the charcoal by adding a known volume of desorbing solvent, usually carbon disulfide. The organics end up in the carbon disulfide. The carbon disulfide is then injected into a gas chromatograph using Flame Ionization Detection. The individual organic vapors can then be identified and quantitated.

The usual charcoal tubes that are used for this type of work contain two sections. One section has approximately 10 milligrams of charcoal and a backup section has 50 milligrams. The backup section is analyzed separately from the main section to determine if there is organic vapor breakthrough in the main section. These particular size tubes have a recommended maximum flow in the neighborhood of 250 to 300 mL/min. The exit of the Model 580 is at 500 mL/min. The most advantageous way of using a smaller charcoal tube would be to split the exit stream and pass it through two parallel charcoal tubes. This would give approximately 250 mL through each tube. For analysis purposes, the charcoal of each tube is removed and combined using double the amount of solvent that would be required for a single tube.

The amount of total air that can be passed through charcoal tubes certainly depends on the concentration of organic vapor in the air. It also depends to some extent on the particular organic vapor. In general, a total sample through the smaller

charcoal tube of 10 liters is a reasonably safe number to use. Since the flow is split exiting the 580B using the smaller charcoal tubes, only 250 mL/min is going through the tube. It would take 40 minutes to accumulate 10 liters passing through each of the tubes. There are charcoal tubes available in the marketplace containing 300 milligrams of charcoal in the front section and 150 milligrams of charcoal in the rear section. These tubes have correspondingly larger diameter and can accommodate higher volumetric throughputs. One of these tubes could be hooked to the exit of the 580B without doing the split. Conceivably since it contains 3 times the amount of charcoal, a safe operating total volumetric throughput would be approximately 30 liters. This would be a full hour's operating time on the Model 580B. Again, it must be stressed that the 580B when used in the particular form, is not being used as a personnel sampler to end up with the time weighted average concentration over an eight hour period. The intent here is to identify the high level organics observed on the 580B and to quantitate them following identification to determine the safe working area.

## SECTION VII

### Communication

The 580B provides a serial (as opposed to parallel) communication port. There is also a communication cable provided for easy link up to a serial printer or RS-232 port of a computer. Logged data may be "dumped" (sent through the communication port) to a serial printer. Many of the 580B parameters may be set by a remote computer by using the serial port and the 580B communication software (the software is an option part number 580A-9014).

#### 7.1 PRINTER

The 580B can be instructed to send all of its logged data through the serial port to a printer (or a dumb terminal). The 580B printer mode should be selected (see section 2.7.4). The serial communication cable should then be plugged into the RS-232 port at the rear of the instrument and the other end of the cable plugged into the serial port of a printer. The 580B should finally be instructed to output to the printer (see section 2.7.1).

#### 7.2 COMPUTER

The 580B provides capabilities for remote operation. Appendix A includes a detailed technical explanation of the 580B printer and computer interface protocol. The information in this appendix is sufficient for custom software to be developed for interfacing to the 580B. Thermo Environmental however has developed communication software which implements some of the available communication capabilities in a simple "menu driven" format. Remote communication may also be accomplished by using generic communication software such as CrossTalk. Appendix A will be helpful if this route is taken.

**NOTE :** Generally the RS-232 port on an IBM PC (or compatible) is a male connector. Since the communication cable provided with the 580B is also male, a "gender changer" (a DB-25 connector which converts from male to female) is needed.

#### 7.3 COMMUNICATION SOFTWARE (OPTIONAL)

There is communication software available which will run on an IBM PC or compatible. The software provides the capability of obtaining or changing the 580B parameters (alarm setting, response factor, or operating mode to name a few). Logged data may be stored to disk or printed to a parallel printer. Concentrations may be read and displayed on the computer screen. There are a few operations which may not be accomplished remotely (for obvious reasons). The lamp may not be changed remotely. The lamp and pump may not be turned on from the computer either.

**NOTE :** The communication software will not work unless the 580B is attached via the communication cable.

##### 7.3.1 HOW TO GUIDE FOR COMMUNICATION SOFTWARE

- #1. The 580B must be turned on and connected to the computer's RS-232 port. The 580B must be in the computer mode (this is the default setting).
- #2. The floppy disk should be inserted into the computer. Type 580A (this software was originally developed for the 580A) and then hit return. The introduction screen will appear.
- #3. The software defaults to 2400 baud (as does the 580B). If some other baud rate is desired it must match the setting on the 580B.
- #4. After selection of the baud rate press return. The main menu will appear.

**NOTE :** If the computer's screen goes blank and the main menu does not appear then there is a problem with the communication link. Check to be sure that the communication cable is plugged into the RS-232 port and that the 580B is on.

## SECTION VIII

### Flow Chart

There are two flow charts which illustrate the structure of the 580B software. The first is a "Quick Start-up" flow chart. Much of the detail is not included in this flow chart in order to diagram the basic structure of the software. The second flow chart includes extensive detail of each screen and the function of the seven buttons. These flow charts provide an easy method for determining how to get at each of the many facilities provided by the 580B.

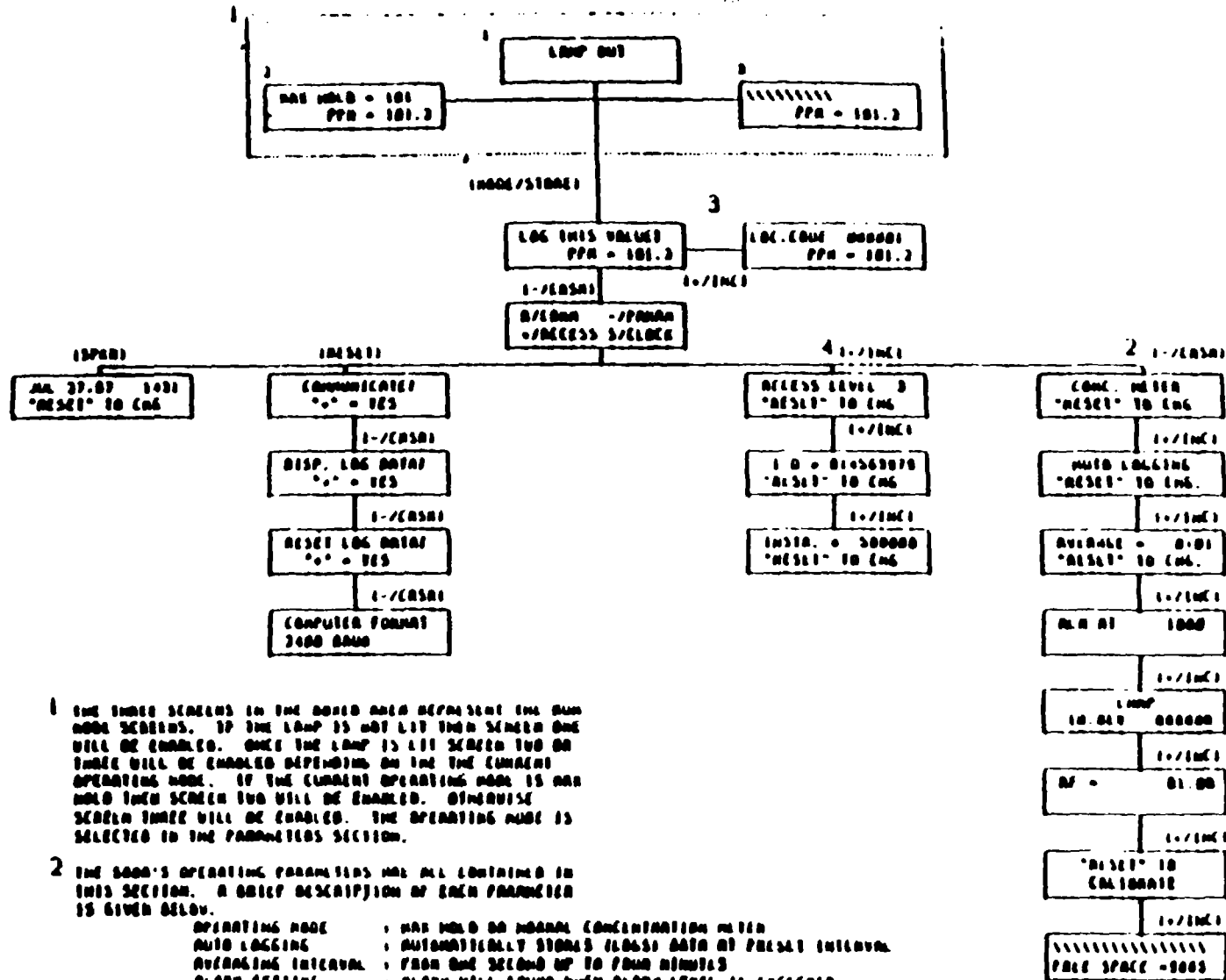
#### 8.1 QUICK START-UP

The Quick Start-up flow chart shows each of the top level screens. The screens are ordered according to the hierarchy of the 580B software. The particular button (which advanced the 580B to the next screen) is shown in parenthesis above each screen. This flow chart does not illustrate any of the associated screens or operations (see the detailed flow chart for more in depth information).

The Quick Start-up flow chart should be fully understood before moving on to the more detailed flow chart. The best way to learn each of the flow charts is to have the 580B with You and to follow along verifying each step.

#### 8.2 DETAILED FLOW CHART

The detailed flow chart illustrates many of the lower level screens as well as the function of buttons. Screens are shown in rectangles with the text written inside. The buttons are shown in ellipses (actually a rather flattened ellipse) with the button identifier written inside. There are a few conventions which need to be explained. The button identifiers have been abbreviated. For example the + / INC button is simply denoted as +. When two buttons need to be pressed simultaneously each identifier is shown with a slash between them. For example RESET / + indicates that the RESET and + / INC buttons should be pressed together. Arrows indicate the direction of flow from one screen to the next.



1 THE THREE SCREENS IN THE BOXED AREA REPRESENT THE MAIN MODE SCREENS. IF THE LAMP IS NOT LIT THEN SCREEN ONE WILL BE ENABLED. ONCE THE LAMP IS LIT SCREEN TWO OR THREE WILL BE ENABLED DEPENDING ON THE CURRENT OPERATING MODE. IF THE CURRENT OPERATING MODE IS MAIN MODE THEN SCREEN TWO WILL BE ENABLED. OTHERWISE SCREEN THREE WILL BE ENABLED. THE OPERATING MODE IS SELECTED IN THE PARAMETERS SECTION.

2 THE BOON'S OPERATING PARAMETERS ARE ALL CONTAINED IN THIS SECTION. A BRIEF DESCRIPTION OF EACH PARAMETER IS GIVEN BELOW.

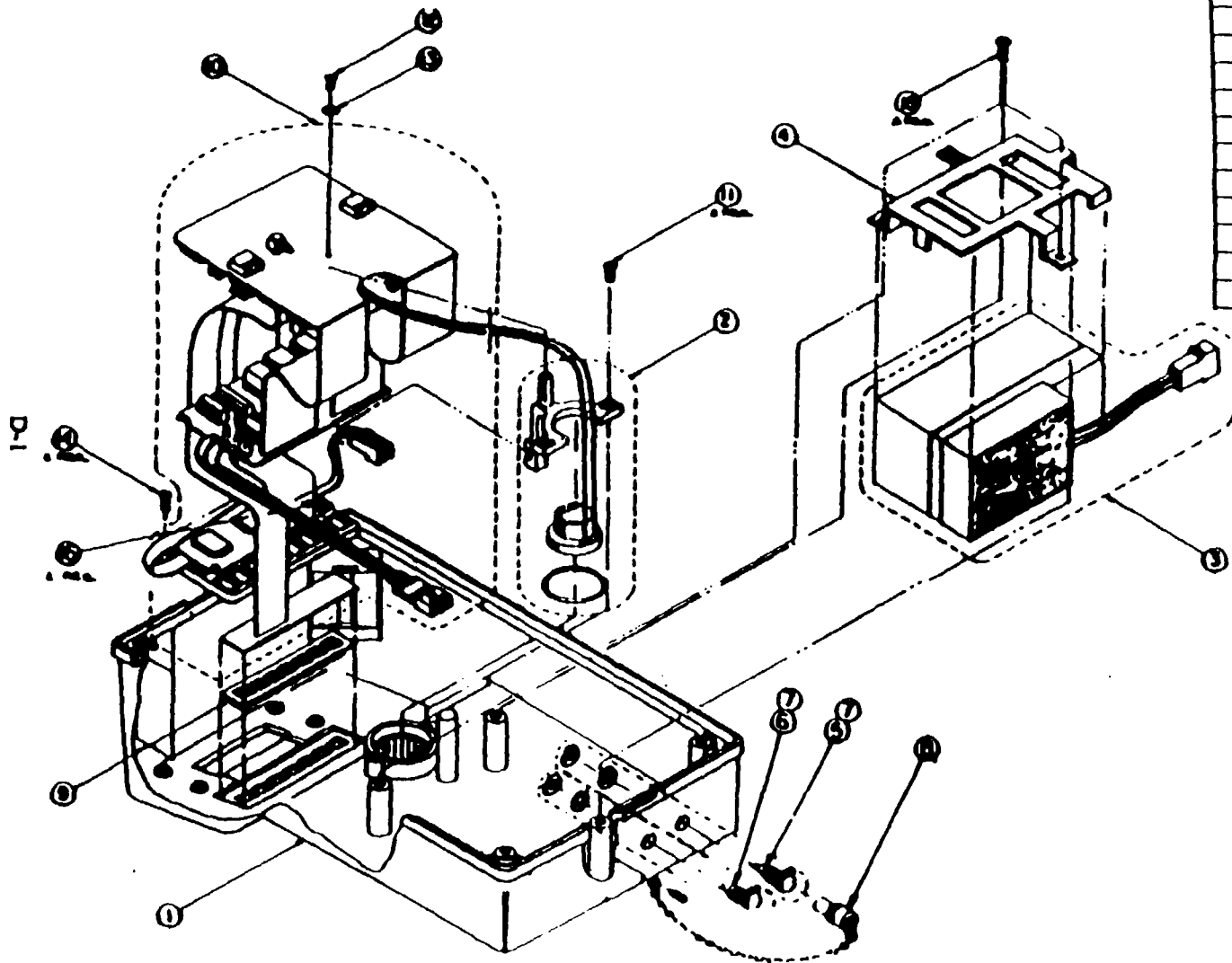
OPERATING MODE	: HAS HOLD OR NORMAL CONCENTRATION WITH
AUTO LOGGING	: AUTOMATICALLY STORES LOGGED DATA AT PRESET INTERVAL
AVERAGING INTERVAL	: FROM ONE SECOND UP TO FOUR MINUTES
ALARM SETTING	: ALARM WILL SOUND WHEN ALARM LEVEL IS EXCEEDED
LAMP SETTING	: SELECTS 10.0 OR 11.0 BY LAMP SERIAL NUMBER ALSO
RESPONSE FACTOR	: CORRELATES AN ANALOGIC TO THE CALIBRATION GAS
CALIBRATION	: SECTION WHERE BOON IS CALIBRATED
FREE SPACE	: INDICATION OF AMOUNT OF ROOM LEFT FOR DATA STORAGE

3 THESE ARE THE SCREENS USED FOR LOGGING (STORING) DATA POINTS. AFTER ENTERING THE DESIRED LOCATION CODE, SIMPLY PRESSING THE MODE/STORE SWITCH WILL LOG THE VALUE INS WELL AS A DATE AND TIME STAMP AND RETURN OPERATION TO THE MAIN MODE.

4 THE ACCESS (SECURITY) LEVEL IS SET IN THIS SECTION. ACCESS LEVEL THREE GIVES THE OPERATOR ACCESS TO ALL OF THE BOON'S FACILITIES. LOWER ACCESS LEVELS ARE PROGRESSIVELY MORE RESTRICTIVE. ACCESS LEVEL ZERO ONLY ALLOW READING AND LOGGING OF DATA



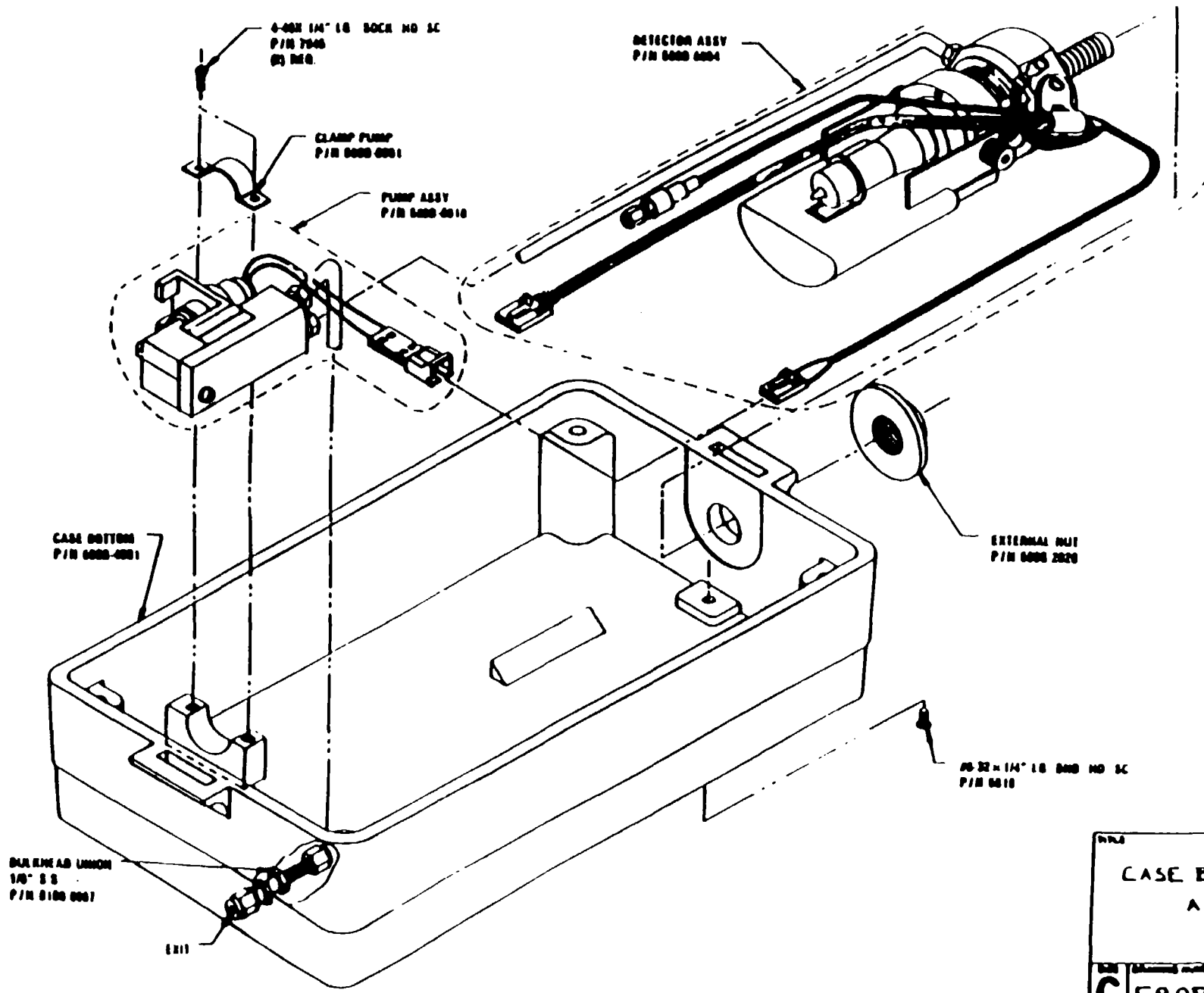
BILL OF MATERIAL			
ITEM	PART NO	DESCRIPTION	QTY
1	0000-0007	CASE TOP	1
2	000A-0015	SPEAKER ASST (120PH)	1
3	0000-0020	BATTERY ASST	1
4	0000-0007	BATTERY HOLDER	1
5	0000-0014	POWER B WARRNG SS (12000)	1
6	0000-0016	DS 720 WARRNG SS ASST (12000)	1
7	0000-0000	SWGT COVER	1
8	0000-0007	OPERATING PLUG (114300)	1
9	0070-0007	SLYPAD	1
10	0000-0000	P.C. NO. 001 ASST	1
11	0000	0.20" x 1/4" P17 HD BRN DC	2
12	0016	1.40" x 1/16" BRN HD DC	1
13	7634	NYLON WASHER	1
14	0000	0.20" x 1/2" P40 HD DC	2
15	0000	0.20" x 1/2" BRN HD DC	2
16	0007	0.20" x 1/2" BRN HD DC	2



CASE TOP ASST  
 C150084006



D-2



CASE BOTTOM ASSY		
REV	DESCRIPTION	DATE
C	580B-6002	

# COMMON ORGANIC SOLVENTS AND GASES DATA SHEET

CHEMICAL MATERIALS	F.W.(G/MOLE)	DENSITY(G/ML)	BP(°C)*	I.P.(EV)**	TWA(PPM)**
Acetaldehyde	44.05	0.788	21	10.21	200
Acetamide	59.07	1.159	221	9.77	
Acetic acid	60.05	1.049	116-117	10.37	10
Acetic anhydride	102.1	1.10	138-140	9.88	5
Acetone	58.1	0.79	56	9.69	1000
Acetonitrile	41.1	0.79	82	12.22	40 cell
Acetophenone	120.15	1.033	202	9.27	
Acetyl bromide	122.96	1.52	75-77	10.55	
Acetyl chloride	78.50	1.104	52	11.02	
Acetylene	26.02	0.90		11.41	
Acrolein	56.06	0.8389	53	10.10	0.1
Acrylonitrile	53.06	0.8004	77	10.91	10
Allyl alcohol	58.1	0.85	96-98	9.67	2
Allyl chloride	76.5	0.94	44-46	9.9	1
Aniline	93.1	1.02	184	7.70	5
Anisole	108.13	0.9956	154	8.22	
Ammonia	17.03	gas		10.15	
Arsine	77.9	gas			0.05
Benzaldehyde	106.12	1.053	178-185	9.53	
Benzene	78.1	0.88	80	9.25	
Benzonitrile	103.12	1.010	188	9.71	
Benzotrifluoride	146.11	1.1886	102	9.68	
Benzyl chloride	126.6	1.10	177-181	9.14	1
Biophenyl	154.21	0.992	255		
Bromine	159.81	3.1023	58.8	10.55	0.1
Bromobenzene	157.02	1.495	156	8.98	
1-bromobutene	137.03	1.276	100-04	10.13	
2-bromobutene	137.03	1.255	91	9.98	
1-bromo-2-chlorethene	143.42	1.723	106-07	10.63	
Bromochloromethane	129.39	1.991	68	10.77	
1-bromo-2-fluorobenzene	175.01	1.593	150	8.99	
Bromoform	252.8	2.9	150-01	10.47	0.5
1-bromo-2-methyl propane	137.03	1.260	90-92	10.09	
2-bromo-2-methyl propane	137.03	1.189	72-74	9.89	
1-bromopentane	151.05	1.218	130	10.10	
1-bromopropane	123.00	1.354	71	10.18	
2-bromopropene	123.00	1.310	59	10.08	
1-bromopropene	120.98	1.413	58-63	9.30	
3-bromopropene	120.98	1.398	70-71	9.70	
2-bromothiophene	163.04	1.684	149-151	8.63	
M-bromotoluene	171.04	1.4099	183.7	8.81	
O-bromotoluene	171.04	1.431	58-60	8.79	
P-bromotoluene	171.04	1.431	184	8.67	
1,3-butadiene	54.1	gas	9.07		1000
Butane	58.12	gas	10.63		
	90.19	.842	9.14		

- \* BP = Boiling Point Degrees Centigrade
- \*\* IP = Ionization Potential
- \*\*\* TWA = Time Weighted Average = Parts Per Million

TABLE E-1

CHEMICAL MATERIALS	F.W.(G/MOLE)	DENSITY(G/ML)	BP(°C)*	I.(PEV)**	TWA(PPM)***
2-butanone	72.1	0.81	80	9.53	
1-butene	56.10	0.6255		9.58	200
N-butyl acetate	116.2	0.88	124-26	10.01	
S-butyl acetate	116.2	0.88	111-12	9.91	150
N-butyl alcohol	74.1	0.81	117-7	10.04	150
N-butyl amine	73.1	0.73	78	8.71	100
S-butyl amine	73.1	0.73	63	8.70	5
T-butyl amine	73.1	0.73	46	8.64	5
N-butyl benzene	134.21	0.8604	183	8.69	5
S-butyl benzene	134.21	0.8604	173-04	8.68	
T-butyl benzene	134.21	0.8669	169	8.68	
N-butyraldehyde	72.10	0.8016	75	9.86	
N-butyric acid	88.10	0.959	162	10.16	
N-butyronitrile	69.10	0.7954	115-17	11.67	
Camphor	152.2	0.99	204	8.76	2 mg/m
Carbon dioxide	44.01	gas		13.79	5000
Carbon Monoxide	28.01	gas		14.01	50
Carbon tetrachloride	153.8	1.59	77	11.47	10
Chlorine	70.90	gas		11.48	1 cell
Chlorobenzene	112.6	1.10	132	9.07	5
Chloroform	119.4	1.48	60.5-61.5	11.37	50 cell
1-chloro-2-methylpropane	92.57	.883	68-69	10.66	
2-chloro-2-methylpropane	101.64	.851	51-52	10.61	
1-chloropropane	78.54	.892	46-47	10.82	
2-chloropropane	78.54	.859	34-36	10.78	
3-chloropropane	76.53	.939	44-46	10.04	
2-chlorothiophene	118.59	1.286	127-29	8.68	
M-chlorotoluene	126.58	1.076	160-162	8.83	
O-chlorotoluene	126.58	1.0826	157-159	8.83	
P-chlorotoluene	126.58	1.0697	162	8.70	
M-cresol	108.1	1.034	203	8.52	5 cell
O-cresol	108.1	1.048	191	8.50	5 cell
P-cresol	108.1	1.034	202	8.38	5 cell
Crotonaldehyde	70.09	0.853	104	9.73	2
Cumene	120.2	0.86	152-154	8.75	50
Cyanogen	52.04	0.9537		13.80	
Cyclohexane	84.2	0.81	80.7-81	9.98	300
Cyclohexane	100.2	0.90	160-161	10.0	50
Cyclohexanone	98.1	0.95	155	9.14	50
Cyclohexene	82.1	0.81	83	8.95	300
Cyclo-octatetraene	104.15	0.925	142-43	7.99	
Cyclopentane	70.13	0.7460	50	10.53	
Cyclopentanone	84.11	1.4366	130-131	9.26	
Cyclopentene	68.12	0.744	44	9.01	
Cyclopropane	42.08	gas		9.91	
Diborane	27.68	gas		11.00	
Diazomethane	42.0	gas		9.0	0.2

\* BP = Boiling Point Degrees Centigrade

\*\* IP = Ionization Potential

\*\*\* TWA = Time Weighted Average = Parts Per Million

CHEMICAL MATERIALS	F.W.(G/MOLE)	DENSITY(G/ML)	BP(°C)*	I.P(EV)**	TWA(PPM)*
Dibromodifluoromethane	209.83	2.297	22-23	11.07	
1,2-dibromoethane	187.87	2.180	131-132	9.45	
1,3-dibromopropane	201.90	1.937	167	10.07	
Dibutylphthalate	278.3	1.04	340		
M-dichlorobenzene	147.01	1.258	172-73	9.12	5 mg m
O-dichlorobenzene	147.01	1.306	179-180	9.07	50
P-dichlorobenzene	147.01	1.241	173	8.94	50
1,1-dichloroethane	99.0	1.18	57	11.06	100
1,2-dichloroethane	98.96	1.256	83	11.12	
1,2-dichloroethylene	97.0	1.25	46-60	9.66	200
Dichloromethane	84.93	1.325	39.8-40	11.35	
1,2-dichloropropane	112.99	1.156	95-96	10.87	
1,3-dichloropropane	112.99	1.190	120-22	10.85	
2,3-dichloropropane	110.97	1.204	94	9.82	
N,N-diethyl acetamide	115.18	0.925	182-86	8.60	
Diethylamine	73.1	0.71	55	8.01	25
Diethyl ether	74.12	0.7134	34.6	9.53	
N,N-diethyl formamide	101.15	0.908	176-77	8.89	
Diethyl ketone	86.13	0.816	102	9.32	
diethyl sulfide	90.19	.837		8.43	
Diethyl sulfite	138.19	1.883	158-60	9.68	
Dihydropyran	84.12	0.922	86	8.34	
Diisopropylamine	101.2	0.72	84	7.73	5
1,1-dimethoxyethane	90.12	0.863	64	9.65	
N,N-dimethyl acetamide	87.12	0.937	164.5-66	8.81	10
Dimethyl amine	45.1	0.68		8.24	10
N,N-dimethyl aniline	122.2	0.96	193-94	7.13	
2,2-dimethyl butane	86.18	0.649	50	10.06	
2,3-dimethyl butane	86.18	0.662	50	10.02	
3,3-dimethyl butanone	100.16	0.801	106	9.17	
N,N-dimethyl formamide	73.09	0.9445	153	9.12	10
Dimethyl sulfide	63.13	0.846	38	8.69	
P-dioxane	88.1	1.03	100-102	9.13	100
Dipropyl amine	101.19	0.738	105-110	7.84	
Durene	134.12	0.84	80-82	8.03	
Epichlorohydrin	92.5	1.18	115-117		5
Ethane	30.07	gas		11.65	
Ethanethiol	62.13	0.8315	35	9.29	
Ethyl acetate	88.1	0.90	76.5-77	10.11	
Ethyl alcohol	46.1	0.80	78	10.48	1000
Ethyl amine	45.1	0.69	19-20	8.86	10
Ethyl benzene	106.2	0.87	136	8.76	100
Ethyl bromide	109.0	1.45	37-40	10.29	200
Ethyl butyl ketone	114.2	0.82	146-49	9.02	50
Ethyl chloride	64.52	0.9214		10.98	1000
Ethyl disulfide	122.25	0.993	153	8.27	
Ethylene dibromide	187.9	2.17	131-132	10.52	20
Ethylene dichloride	99.0	1.26	83	11.32	50

- \* BP = Boiling Point Degrees Centigrade
- \*\* IP = Ionization Potential
- \*\*\* TWA = Time Weighted Average = Parts Per Million

CHEMICAL MATERIALS	F.W.(G/MOLE)	DENSITY(G/ML)	BP(°C)*	I.(EV)**	TWA(PPM)***
Ethyl ether	74.1	0.73	34.6	9.59	
Ethyl formate	74.1	0.92	52-54	10.61	400
Ethyl iodide	155.98	1.950	67-73	9.33	100
Ethyl isothiocyanate	87.15	1.003	60	9.14	
Ethyl methyl sulfide	76.16	0.842	66-67	8.55	
Ethyl nitrate	75.07	0.90	112	11.22	
Ethyl propionate	102.13	0.891	99	10.00	
Ethyl thiocyanate	87.14	1.007		9.89	
Ethylbenzene	102.13	0.9300	142-44	8.82	
Flourine	37.99	gas		15.70	
Flourobenezene	96.10	1.024	85	9.20	0.1
O-flourophanol	112.10	1.256	172-74	8.95	
M-flourotoluene	110.13	0.997	178	8.92	
O-flourotoluene	110.13	1.004	171-172	8.92	
P-flourotoluene	110.13	1.001	185	8.79	
Formaldehyde	30.03	1.083		10.87	
Formamide	45.04	1.1334	210	10.25	3
Formic acid	46.02	1.220	100-101	11.05	
2-furaldehyde	96.09	1.160	182	9.21	250
Furan	68.07	0.9371		8.89	
Heptane	100.2	0.68	98	10.08	500
2-heptanone	114.18	0.8068	149-50	9.33	
Hexane	86.2	0.66	68-69	10.18	500
1-hexane	84.16	0.673	64	9.46	
Hexone	100.2	0.80		9.53	100
Hydrogen	2.017	gas		15.43	
Hydrogen bromide	80.92	gas		11.62	3
Hydrogen chloride	36.47	gas		12.74	5 cell
Hydrogen cyanide	27.03	0.687		13.91	10
Hydrogen flouride	20.01	gas		15.77	3
Hydrogen iodide	127.93	gas		10.38	
Hydrogen selenide	80.98	gas		9.88	0.05
Hydrogen sulfide	34.08	gas		9.88	20 cell
Hydrogen tellunde	129.63	gas		9.14	
Iodine	253.81	4.93		9.23	0.1 cell
Iodobenzene	204.02	1.8384	188	8.73	
1-iodobutene	184.02	1.617	130-31	9.21	
2-iodobutene	184.02	1.4991	119-120	9.09	
1-iodo-2-methylpropane	184.02	1.599	120-21	9.18	
				9.02	
1-iodopentane	198.05	1.517	154-55	9.19	
1-iodopropane	169.99	1.743	101-02	9.26	
2-iodopropane	169.99	1.703	88-90	9.17	
O-iodotoluene	218.04	1.713	211	8.62	
M-iodotoluene	218.04	1.698		8.61	
P-iodotoluene	218.04		211.5	8.50	
Isoamyl acetate	130.2	0.88	142	9.94	
Isoamyl alcohol	88.2	0.81	130.1	10.42	100

- \* BP = Boiling Point Degrees Centigrade
- \*\* IP = Ionization Potential
- \*\*\* TWA = Time Weighted Average = Parts Per Million

CHEMICAL MATERIALS	F.W.(G/MOLE)	DENSITY(G/ML)	BP(°C)*	I.P.(EV)**	TWA(PPM)
Isobutyl amine	73.14	0.724	64-71	8.70	
Isobutyl formate	102.13	0.885	98.4	10.46	
Isobutyraldehyde	72.11	0.794	63	9.74	
Isobutyric acid	88.11	0.950	153-54	10.02	
Isoctane	114.2	0.70	98-99	17.9	
Isopentane	114.23	0.692	30	10.32	400
Isoprene	68.12	0.681	34	8.85	
Isopropyl acetate	102.1	0.87	85	9.99	
Isopropyl alcohol	60.1	0.79		10.16	250
Isopropyl amine	59.1	0.69	33-34	8.72	400
Isopropyl benzene	120.2	0.86	152-54	8.75	5
Isopropyl ether	102.2	1.37	68-69	9.20	50
Isovaleraldehyde	86.13	0.785	90	9.71	500
2,3-lutidine	107.15	0.945	162-63	8.85	
2,4-lutidine	107.15	0.927	159	8.85	
2,6-lutidine	107.15	0.9252	143-45	8.85	
Malic anhydride	98.1	0.93	200	11.1	
Mesitylene	120.19	0.8637	162-64	8.40	
Mesityl oxide	98.14	0.8592	129	9.08	
Methane	16.04	gas		12.98	
Methanethiol	48.11	0.96		9.44	
N-methyl acetamide	73.10	0.957	204-05	8.90	
Methyl acetate	74.08	0.9279	57.5	10.27	
Methyl acrylate	86.1	0.96	80	9.9	10
Methyl amine	31.06	gas	48	8.97	
Methyl bromide	95.0	gas		10.53	
2-methyl-1-butane	70.16	0.650	31	9.12	
3-methyl-1-butane	70.14	0.627	20	9.51	
3-methyl-2-butane	70.14	0.643		8.67	
Methyl butyl ketone	100.6	0.83	127	9.34	100
Methyl butyrate	102.13	0.898	102-103	10.07	
Methyl chloride	50.5			11.28	100
Methyl cyclohexane	98.19	0.770	101	9.85	
Methyl disulfide	94.20	1.046	109	8.46	
Methyl ethyl ketone	72.10	0.805	80	9.53	
Methyl formate	60.1	1.34	34	10.815	100
2-methyl furan	82.10	0.827	63-66	8.39	
Methyl iodide	142.0	2.28	41-43	9.54	
Methyl isobutyl ketone	100.2	0.80	117-18	9.30	100
Methyl isobutyrate	102.13	0.891	90	9.98	
Methyl isopropyl ketone	86.12	0.805	94-95	9.32	
Methyl isothiocyanate	73.12		37-39	9.25	
Methyl methacrylate	100.1	0.94	100	9.9	100
1-methyl naphthalene	142.20	1.001	240-243	7.96	
2-methyl naphthalene	142.20	1.000	241-242	7.96	
2-methyl pentane	86.18	0.653	62	10.12	
3-methyl pentane	86.18	0.664	64	10.08	
Methyl propionate	88.11	0.915	79	10.15	

- \* BP = Boiling Point Degrees Centigrade
- \*\* IP = Ionization Potential
- \*\*\* TWA = Time Weighted Average = Parts Per Million

CHEMICAL MATERIALS	F.W.(G/MOLE)	DENSITY(G/ML)	BP(°C)*	I.P(EV)**	TWA(PPM)***
Methyl propyl ketone	86.13	0.809	100-01	9.39	
2-methyl styrene	165.4	1.068	131	10.07	
Monomethyl aniline	107.16	0.989			
Monomethyl hydrazine	46.1	0.87			
Morpholine	87.1	1.01	129	8.88	20
Nephtalene	93.7	1.16	217	8.12	10
Nitric oxide	162.2	1.01		9.25	
P-nitroaniline	138.1				10
Nitrobenzene	123.1	1.21	210-211	9.92	10
4-nitrobiphenyl	199.2				
P-nitrochlorobenzene	157.6	1.52		9.96	
Nitrogen dioxide	46.01	1.448		9.78	1.0 mg m
Nitroethane	75.1	1.38	112	10.81	100
Nitromethane	61.0	1.13	100.8-101	11.08	100
1-nitropropane	89.1	0.99	131-32	10.88	25
2-nitropropane	89.1	0.98	120	10.71	25
N-nitrosodimethylamine	74.1	1.00	153	9.07	
Nitrotoluene	137.1	1.16	225-238	11.63	5
Oxygen	31.9988	gas		12.08	
Ozone	48.00	gas		12.08	
Pentaborane	63.17	0.61		10.40	
Pentane	72.15	0.62638	35	10.35	
2,4-pentanedione	70.13	0.6429	140.4	8.87	
1-pentene	70.13	0.6503	29.9-30.1	9.50	
Phenetol	122.16	0.967	169-70	8.13	
Phenol	94.1	1.07	182	8.50	5
Phenyl hydrazine	108.1	1.1	238-41	7.86	5
Phenyl isocyanate	119.12	1.0887	162-63	8.77	
Phenyl isothiocyanate	135.18	1.1288	221	8.52	
Phosgene	98.9	gas		11.77	0.4 mg m
Phosphine	34.0	gas			0.3
Phosphorous pentachloride	208.2	1.6		10.7	1 mg m
Phosphorous trichloride	137.3	1.57	76	10.5	
2-picoline	93.12	0.950	128-29	9.02	
3-picoline	93.12	0.9613	144	9.02	
4-picoline	93.12	0.9571	145	9.04	
Propane	44.09	gas		11.07	
1-propanethiol	76.16	0.841	67-68	9.20	
Propiolactone	72.06	1.146	162	9.70	
Propionic acid	74.08	0.99336	141	10.24	
Propionaldehyde	58.08	0.8071	46-50	9.98	
Propionitrile	55.08	0.7818	97	11.84	
N-propyl acetate	102.1	0.84	120	10.04	200
Propyl alcohol	60.10	0.804	97	10.20	
Propyl amine	59.11	0.719	48	8.78	
Propyl benzene	120.20	0.862	159	8.72	
Propylene	42.08	gas		8.73	
Propylene oxide	58.08	0.859	34	10.22	

- \* BP = Boiling Point Degrees Centigrade
- \*\* IP = Ionization Potential
- \*\*\* TWA = Time Weighted Average = Parts Per Million

CHEMICAL MATERIALS	F.W.(G/MOLE)	DENSITY(G/ML)	BP(°C)*	I.P(EV)**	TWA(PPM)*
Propyl ether	102.17	0.7360	88-90	9.27	
Propyl formate	88.10	0.901		10.54	
Pyrene	202.3	gas		7.41	
Pyridine	79.1	0.98	115	9.32	5
Pyrrrole	67.09	0.9691	131	9.20	
Styrene	104.14	9.9059	145-146	8.47	
Styrene oxide	120.2	1.054	194	9.04	
Tetrachloroethylene	165.9	1.63	121	9.32	100
Tetrahydrofuran	72.10	0.8892	67	9.54	
Tetrahydropyran	86.13	0.8814	88	9.26	
Thiophene	84.1	1.53	84	8.86	
Toluene	92.13	0.866	111	8.82	
O-toluidine	107.2	1.01	199-200	7.44	5
Trichloroethene	131.40	1.4649	87	9.45	
Triethylamine	101.19	1.069	88.18	7.50	
Trimethyl amine	59.11	0.636	3-4	7.82	
2,2,4-trimethyl pentane	114.23	0.692	98-99	9.86	
Tripropyl amine	143.27	0.753	155-58	7.23	
Valeraldehyde	86.13	0.8095	103	9.82	
Valeric acid	102.13	0.939	185	10.12	
Vinyl acetate	118	0.94	72-73	9.19	10
Vinyl bromide	106.96	1.517	16	9.80	
Vinyl chloride	62.5	gas		10.00	1
Water	18.016	1.00	100	12.59	
M-xylene	106.16	0.8684	138-39	8.56	100
O-xylene	106.16	0.8801	143-45	8.56	100
P-xylene	106.16	0.8614	138	8.45	100

- \* BP = Boiling Point Degrees Centigrade
- \*\* IP = Ionization Potential
- \*\*\* TWA = Time Weighted Average = Parts Per Million



# MODEL 580A

## Dilution Probe Operation

### 1. General

The dilution probe is constructed of stainless steel and Teflon, with a charcoal filter mounted on the dilution inlet. The purpose of the charcoal filter is to provide hydrocarbon free air to the probe assembly so that the dilution of the incoming sample is not affected by the dilution air. The charcoal filter should be changed every 3 months to insure proper operation eliminating the problem of hydrocarbons breakthrough. It is easy to evaluate the performance of the charcoal, by challenging the Model 580A with hydrocarbon free air, then introducing a standard through the charcoal filter, with the inlet of the probe plugged. If there is break through, through the charcoal filter, a reading other than zero will be observed on the readout.

Another important part of the dilution probe is the 10 micron filter that is placed in the inlet of the probe assembly. The flow through this may reduce with time, by dirt that is collected on the inlet filter. This filter should be changed on a regular basis, depending upon the operator's experience and the environment in which he is working.

It is important to realize that the charcoal filter is not a totally efficient device. It does not adsorb ethane and methane, thus passing these materials. This does not cause a problem with the 580A, however, because the photo ionization detector does not respond to ethane and methane.

### 2. Technical Consideration

**NEED FOR DILUTION** — The Model 580A dilution system was developed to increase the dynamic range of the Model 580A. As the instrument was manufactured, it had a workable range of 0 to 2,000 ppm. Above this upper limit, the detector is found to be non-linear. In the case of the new 580A, it will lock out. To meet the requirements of fugitive emission measurements as defined in EPA Method 21, there is the need to make measurements above the 2,000 ppm level. To accomplish this using a detector system that is limited by linearity, a dilution probe was developed. This probe provides a nominal 10 to 1 dilution ratio, increasing the dynamic range of the Model 580A from 2,000 to 20,000 ppm.

### 3. Calibration of the Dilution Probe

The dilution probe is not factory calibrated. It has been tested and evaluated to verify proper performance. It is the responsibility of the operator to properly calibrate the dilution probe. The following is a simple procedure for this activity:

#### *Customer Calibration Procedure*

1. The performance of the 580A or 580B should have previously been verified and calibrated.
2. Place the 580A or 580B in close proximity to a standard with the appropriate calibration range. For example, if the instrument is to be used in a 5,000 ppm sampling range, then a standard of that concentration should be selected.
3. Connect the dilution probe making sure that the charcoal filter and the 10 micron filter are in place to the front of the 580A or 580B.
4. Challenge the instrument with the new standard gas and adjust the micro metering valve until a tenth of the reading is seen on the instrument readout.
5. As in the example of the 5,000 ppm standard, 500 ppm should be seen on the readout.

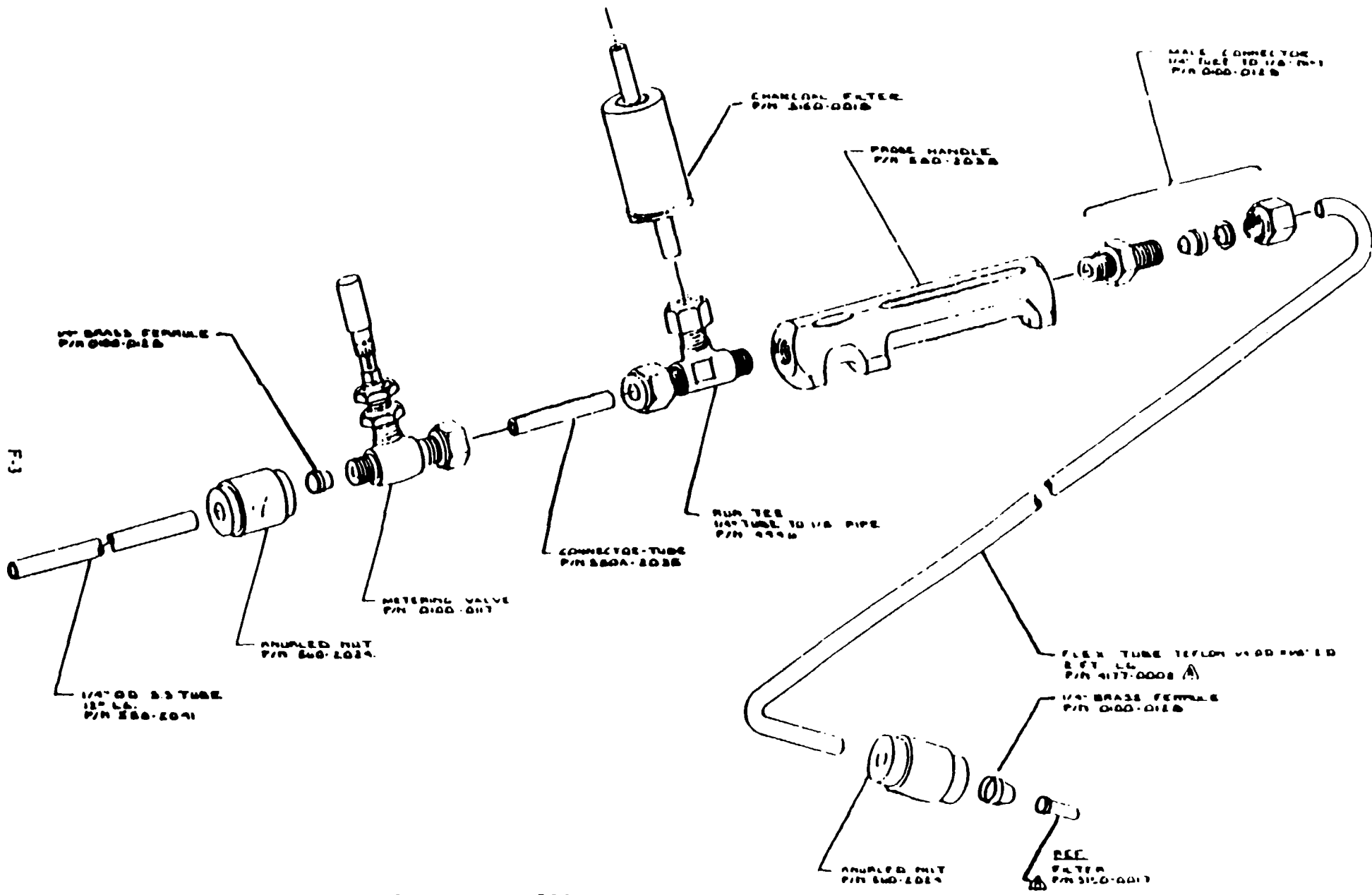
6. This is all that is required to calibrate the 580A or 580B.

**NOTE:** It is important that both zero and span of the 580A have been properly verified prior to initiating this procedure. It is very simple after using the dilution probe, to remove it and recheck the performance of the instrument on your low concentration standard.

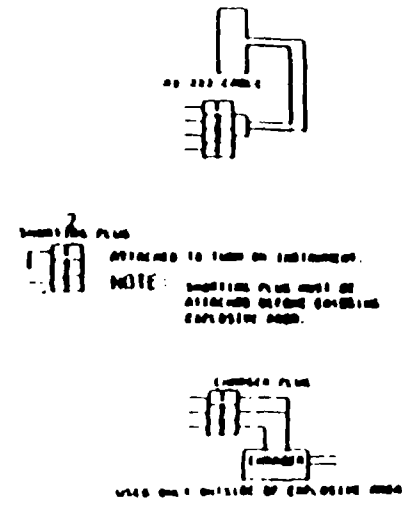
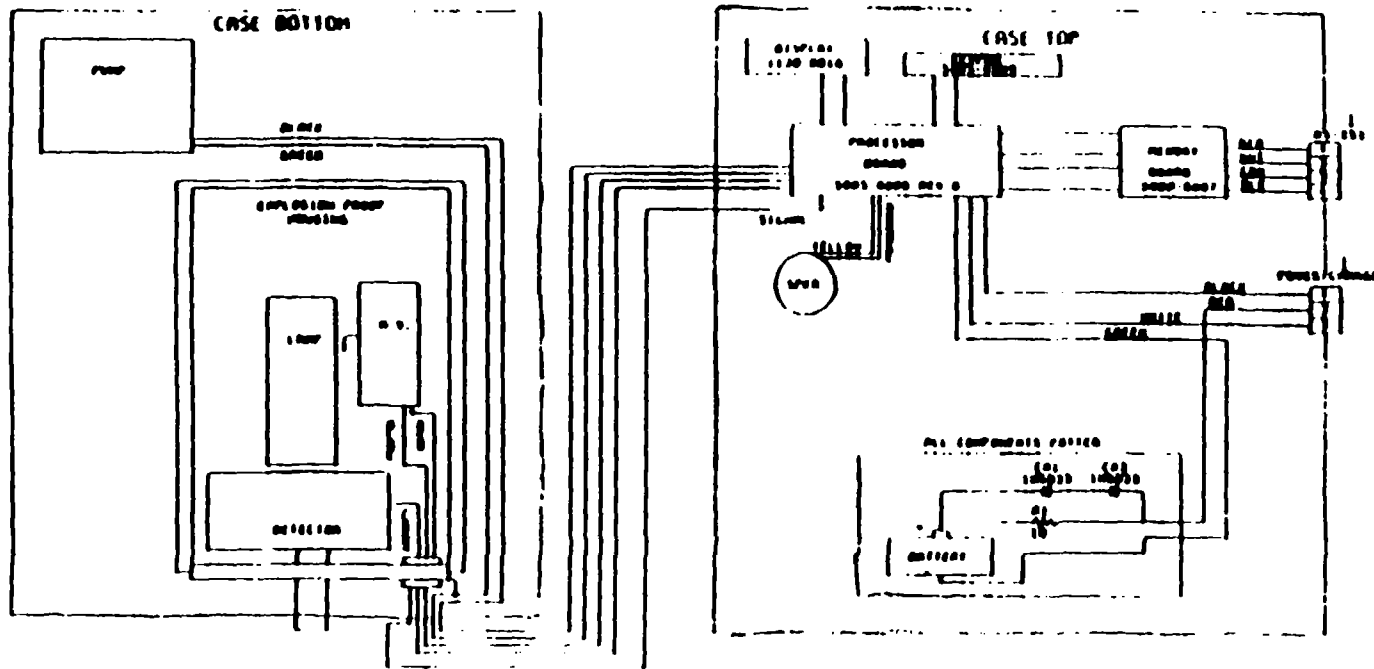
- It should be noted that due to the environment that you are operating in, there may be a change in the back pressure of the charcoal filter and the 10 micron filter. Any changes in these over a period of time will cause a change in the split ratio of the dilution probe. Therefore, it is important to calibrate the dilution probe as regularly as you calibrate the 580A or 580B.

#### **REPLACEMENT PARTS**

- |                           |           |
|---------------------------|-----------|
| 1. Inlet Probe Assy.      | 580A-6016 |
| 2. Charcoal Filter        | 3150-0018 |
| 3. Inlet Filter 10 Micron | 3150-0017 |



VARIABLE DILUTION PROBE ASSY. #580A-6033



- 1 CONNECTIONS MOUNTED ON REAR OF CASE TOP.
- 2 EXPLOSION PROOF IS RETURNED TO PREVENT AIR LOSS



# APPENDIX A

## Communication

### A-1 Introduction

The 580B is capable of communicating over an RS-232 link with any peripheral device which adheres to the communication protocol outlined in this document. The 580B will communicate with a peripheral device in one of two modes. In the PRINTER mode the 580B responds to commands from its keypad and can be commanded to send characters to the RS-232 port to a peripheral device. In the COMPUTER mode the 580B responds to commands from a peripheral computer and can be commanded to send and receive data and to perform other tasks. Regardless of the mode used, the 580B sends and expects to receive data in the following format:

No Parity  
1 Start Bit  
8 Data Bits  
1 Stop Bit  
Baud Rate = 150, 300, 600, 1200, 2400, 4800 or 9600

The Baud Rate may be selected from the 580B keypad (see section 2.7)

### A-2 PRINTER MODE Interface

In the PRINTER mode the 580B can be instructed to send its log data out the RS-232 port to a peripheral device as a printer.

The 580B can be manually instructed from its keypad to output its log data. In this case the 580B sends all the log points it has acquired thus far. The log data is saved in 580B memory and will NOT be automatically erased upon power up. While in the PRINTER mode, the 580B log data file must be erased (reset) from the keypad. An example of a log data output is shown on page A-17. Notice that the 580B also sends header information which includes the following parameters: instrument number, user ID, and mode of operation. The date at the top of the header corresponds to the time when the first data point was taken with the parameters set as shown in the header. If any of the parameters are changed and then log data points are acquired, the 580B will send an updated header before it sends the new data points. It is also important to note that every log data point is time stamped to show when it was stored.

#### HARDWARE INTERFACE, PRINTER MODE

580B	PERIPHERAL
TxD (B) _____	RxD _____
CTS (E) _____	(or "printer ready") _____
GND (A) _____	GND _____

The connections shown above are required before the 580B can successfully send its log data to the peripheral. An example of a cable used for PRINTER MODE communication is shown below:

#### SAMPLE CABLE, 580B TO HP THINKJET PRINTER

580B	PRINTER
TxD (B) _____	RxD (3) _____
CTS (E) _____	DTR (20) _____
GND (A) _____	(1) _____
GND (F) _____	GND (7) _____

Thinkjet connector = TRW/CINCH DB-25P plug connector

Please remember that the 580B must be placed into the **PRINTER** mode prior to output of log data to a printer. This is done from the 580B keypad (refer to 580B Technical Manual for key sequence).

## HARDWARE HANDSHAKING. PRINTER MODE

The 580B will send log data out the port to a peripheral device as long as its CTS line is asserted (+V). If the peripheral has temporarily fallen behind, and consequently clears its DTR line (-V), the 580B will stop transmitting data. It will resume transmitting as soon as the peripheral re-asserts (+V) its DTR line.

## A-3 COMPUTER MODE Interface

In the **COMPUTER** mode the 580B will respond to commands sent by a peripheral computer. The 580B will respond to 3 types of commands: **DO**, **GET**, and **SET** commands.

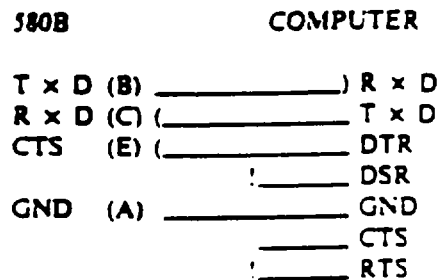
An example of a **DO** command is "**DO RESET LOG (ret)**" in which the 580B is instructed to reset its log which, in effect, clears all previously stored log data points.

A **GET** command such as "**GET ALARM (ret)**" allows the peripheral to change a specified parameter in the 580B to a value provided by the peripheral.

A combination of **DO**, **SET**, and **GET** commands allow the operator at the peripheral to perform a variety of functions needed to prepare a 580B for acquiring data.

The 580B can also be operated under "computer control". For example, the 580B can be commanded to acquire readings at specified intervals and then store the readings in a log data file. The 580B can subsequently be commanded to send its log data to a printer, a file or the screen of the peripheral computer. This can all be accomplished through commands issued by the peripheral computer. So, effectively the 580B is under "computer control".

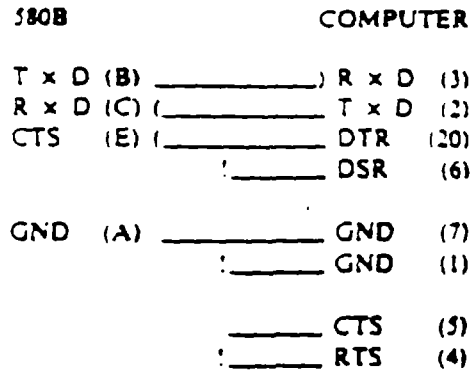
## HARDWARE INTERFACE. COMPUTER MODE



The connections shown above are required before the peripheral computer can successfully communicate with the 580B. In addition, the 580B must be placed into **COMPUTER** mode. This is done from the 580B keypad (refer to 580B Technical Manual for key sequence).

An example of a cable used for COMPUTER MODE communication is shown below:

#### SAMPLE CABLE. 580B TO IBM PC



If the peripheral's DTR line is asserted (+V), the 580B will look for and then respond to peripheral commands. As long as DTR remains high, the 580B will NOT perform functions such as counting, updating the display, storing log data. If DTR is asserted, the 580B will display the following message:

"COMPUTER LINK"  
"WAITING FOR COMM"

The 580B must be allowed 100ms between the time the peripheral asserts DTR and the time it sends the 580B its first message.

If the 580B is busy communicating the display will read:

"COMPUTER LINK"  
"COMMUNICATING"

When DTR is low (-V), the 580B will return to its normal mode of operation where it counts, updates the display, and will NOT respond to peripheral commands.

#### XON/XOFF HANDSHAKING. COMPUTER MODE

If the 580B is transmitting log data and detects that an XOFF has been received, it will stop transmitting. The 580B will not resume transmission until the peripheral device sends XON. The 580B will respond to XON and XOFF characters only if it is NOT communicating with the computer (i.e., if 580B CTS is NOT asserted).

It is important to note that if the 580B receives an XOFF it will stop transmitting and will simply wait for the peripheral to send XON. It will not acquire data, update the display or perform other functions. The 580B is essentially "locked up" until it receives XON. For this reason, it would be good programming practice to send out an XON to the 580B prior to 580B/peripheral communication and afterwards also. Consequently, if an XOFF character is sent to the 580B inadvertently, the 580B will not be locked up indefinitely.

#### PERIPHERAL/580B COMMAND MESSAGES

A command message is a string of upper-case ASCII characters terminated by an ASCII carriage return. The carriage return may immediately follow the command or a space may separate the command and the carriage return as shown in the example below. The command messages which the 580B will accept from the peripheral are listed in TABLE I (see page 8-9). The 580B will accept the messages as shown in TABLE I or the command portion of the message can be abbreviated as follows:

"S R F 01.00 (ret)" instead of  
"SET RESPONSE FACTOR 01.00 (ret)"



Please note that the abbreviation must contain the first letter of each and every word of the command. There are some additional guidelines for abbreviating the SET OPERATING MODE commands. Please see the list of valid abbreviations for these commands on page 18.

If the abbreviated version of a command is sent, an ASCII blank must separate each letter of the command and must separate the command from the data. Note that the command message will contain data only if a SET command is being sent.

If the spelled-out version of a command is sent, an ASCII blank must separate each word of the command and must separate the command from the data.

Every SET command message contains a data value. The data sent as part of a SET command must conform to the formats described in TABLE 1. It is important to note that the 580B does NOT perform error-checking on data sent as part of a SET command. It is up to the user to insure that the data value is "reasonable" and formatted as shown in TABLE 1.

The following are examples of valid command messages:

"SET ACCESS LEVEL 3 (ret)"  
or "S A L 3 (ret)"

"SET REAL TIME 02/15/86 1723 (ret)"  
or "S R T 02/15 86 1723 (ret)"

## 580B PERIPHERAL RESPONSE MESSAGES

A response message is a string of upper-case ASCII characters terminated by an ASCII carriage return. The response messages which the 580B will send to the peripheral are listed in TABLE 1. The messages which the 580B sends in response to a GET command contain data formatted as shown. The notes which follow TABLE 1 describe the GET command response messages in more detail.

## SOFTWARE HANDSHAKING, COMPUTER MODE

Every command message must be preceded by the "WAKE UP/PROCEED" sequence. This sequence begins when the peripheral sends a WAKE UP ("W") character to the 580B. The 580B must respond with a PROCEED ("P") character before the computer can send a command message. In the discussion to follow, the WAKE UP/PROCEED sequence will be referred to as (WAKE UP/PROCEED).

The peripheral sends command messages to the 580B an entire line at a time. When the 580B receives the command line it will echo the line back to the peripheral. The peripheral will examine the echo to determine if the 580B received the command correctly. If the echo was correct, the peripheral will signal the 580B with the PROCEED character. The 580B will then perform the task specified by the command message. In the discussion ahead, the command message and echo sequence will be referred to as (COMMAND/ECHO/PROCEED).

The software handshaking sequences for each of the 3 types of commands are given below:

### DO COMMANDS

The handshake sequence for a DO command is as follows:

1. (WAKE UP/PROCEED)
2. (COMMANDS/ECHO/PROCEED)
3. 580B performs task
4. 580B sends PROCEED or ERR

If the 580B was able to successfully complete the task it will send a PROCEED character in step 4, otherwise it will send the error message ("ERR").

## GET COMMANDS

The handshake sequence below applies to all of the GET commands with the exception of GET LOG DATA and GET CONTINUED LOG:

1. (WAKE UP / PROCEED)
2. (COMMAND / ECHO / PROCEED)
3. 580B sends data message
4. Peripheral echos data message
5. 580B sends PROCEED or ERR

The message sent by the 580B in response to a GET command are shown in TABLE I. When the peripheral receives the message containing the data it echos the entire message back to the 580B. If the echo is correct the 580B will send PROCEED character so that the peripheral knows it received the data correctly. If the echo is not correct, the 580B will send "ERR".

The GET LOG DATA and GET CONTINUED LOG commands differ from the other GET commands in that the 580B sends an indefinite number of data values. The handshake sequence for these commands is as follows:

1. (WAKE UP / PROCEED)
2. (COMMAND / ECHO / PROCEED)
3. 580B sends a log data point message
4. If message = "EOT" (end of transmission) then DONE, otherwise go on to step 5.
5. Peripheral echos entire message
6. 580B sends PROCEED or ERR
7. Peripheral sends PROCEED
8. Go to step 3

In step 4, the 580B sends "EOT" if it has sent all the log data points available. If some time later the peripheral sends "GET CONTINUED LOG (ret)" the 580B will send any additional data points it may have acquired since the GET LOG DATA command. In step 6, the 580B will send PROCEED if the peripheral echoed the message correctly in step 5. The 580B will also increment its data buffer pointer. If however, the peripheral did NOT correctly echo the message in step 5, the 580B will send "ERR" in step 6 and will NOT increment its data buffer pointer. This means that the next time through step 3 the 580B will send the same data point again. In either case, the peripheral must send a PROCEED in step 7.

## SET COMMANDS

The handshaking sequence for a SET command is as follows:

1. (WAKE UP / PROCEED)
2. (COMMAND / ECHO / PROCEED)
3. 580B sets parameter to value
4. 580B sends PROCEED or ERR

In step 3 the 580B sets the parameter specified by the command to the value provided by the peripheral in the command message. The data value sent in the SET command message must be formatted as shown in TABLE I. If the 580B is able to successfully set the parameter it will send the PROCEED character, otherwise it will send "ERR".

### NOTE

The flowcharts shown in figures 1-4 (see pages 8-13 - 8-16) are included to further explain the software handshaking sequences required for successful communication between the peripheral and the 580B.

# TABLE 1

## Message Formats

PERIPHERAL COMMAND	580B RESPONSE
DO COMMANDS	
DO END COMMUNICATIONS (ret)	: (ret)
DO RESET LOG (ret)	: (ret)
GET COMMANDS	
GET ACCESS LEVEL (ret)	ACCESS LEVEL I (ret)
GET ALARM SETTING (ret)	ALARM SETTING IIII (ret)
GET CONTINUED LOG (ret)	(see notes which follow)
GET INSTRUMENT NUMBER (ret)	INSTRUMENT # IIIIII (ret)
GET LOCATION CODE (ret)	LOCATION CODE IIIIII (ret)
GET LOG DATA (ret)	(see notes which follow)
GET OPERATING MODE (ret)	OPERATING MODE: ASCII (50) (ret)
GET MAX READING (ret)	LAST MAX VALUE IIII ASCII (8) (ret)
GET RATEMETER READING (ret)	LAST CONC VALUE IIII ASCII (8) (ret)
GET REAL TIME (ret)	REAL TIME CLOCK II/II/II IIII (ret)
GET USER ID (ret)	USER I.D. # IIIIIIII (ret)
GET RESPONSE FACTOR (ret)	RESPONSE FACTOR II.II (ret)
GET SPAN CONCENTRATION (ret)	SPAN CONCENTRATION IIII (ret)
GET VERSION NUMBER (ret)	580B VERSION 1.0 (ret)
GET LOGGING INTERVAL (ret)	I:II (ret)
SET COMMANDS	
SET ACCESS LEVEL I (ret)	: (ret)
SET ALARM SETTING IIII (ret)	: (ret)
SET INSTRUMENT NUMBER IIIIII (ret)	: (ret)
SET LOCATION CODE IIIIII (ret)	: (ret)
SET OPERATING MODE ASCII (50) (ret)	: (ret)
SET REAL TIME II/II/II, IIII (ret)	: (ret)
SET USER ID IIIIIIII (ret)	: (ret)
SET RESPONSE FACTOR II.II (ret)	: (ret)
SET SPAN CONCENTRATION IIII (ret)	: (ret)
SET LOGGING INTERVAL I:II (ret)	: (ret)

### NOTES ON TABLE 1

The peripheral will receive data back from the 580B in response to a GET command only. The 580B response to a DO or SET command is the PROCEED ("") character. This is because the 580B does not actually return data but signals the peripheral with the PROCEED character if it was able to perform the task requested. If for some reason the 580B is unable to perform the task it will send an error message "ERR" rather than PROCEED.

The data values sent by the peripheral as part of a SET command message and the data received by the peripheral in response to a GET command must be formatted as shown in TABLE I. The data format codes used in TABLE I are described below:

I	a single digit
III II	an integer "string", the number of I's shown indicates the length of the string. Note: the "string" MUST be the length specified, use leading zeros if necessary.
ASCII (n)	an ASCII string with a maximum of n characters

Several of the command messages listed in TABLE I require additional explanation. These comments are listed according to the command name:

#### DO RESET LOG

This command instructs the 580B to clear its log data file. All log data values acquired previously will be erased.

#### GET CONTINUED LOG

This command instructs the 580B to send any log data points acquired since the last GET LOG DATA command. The format of the 580B response will be the same as the response to the GET LOG DATA command. A sample GET LOG DATA response is shown on page E-17.

#### GET LOG DATA

This command instructs the 580B to send all of its log data points. A sample GET LOG DATA response is shown on page 21. The log data file is saved in 580B memory and is NOT automatically erased upon output. The log data file may be erased (reset) with the DO RESET LOG command.

#### GET OPERATING MODE

The 580B responds to a GET OPERATING MODE command by sending a string "MODE:", followed by an ASCII string which describes the current 580B mode of operation. The 580B responses to the GET OPERATING MODE command are listed below:

OPERATING MODE: CONCENTRATION METER NORMAL  
OPERATING MODE: CONCENTRATION METER MAX HOLD

#### GET MAX READING

The 580B responds to a GET MAX READING command by sending the max value as shown in TABLE I. After the 580B sends the max reading it resets the max value to 0.

#### GET REAL TIME

The 580B will return its real time as an ASCII string in the following format: "05/29/86 1422"

#### SET ACCESS LEVEL

The access level must be an integer in the range 0 to 3

## SET INSTRUMENT NUMBER

The instrument number is a string of 6 integers. If the instrument number = 2 then the number must be represented . 000002 (i.e. leading zeros must fill in excess spaces). An example of a valid SET INSTRUMENT NUMBER command is "SET INSTRUMENT NUMBER 000002 (ret)".

## SET LOCATION CODE

The location code is a string of 6 integers. If the location code = 234 then the correct SET LOCATION CODE command is "SET LOCATION CODE 000234 (ret)". (Leading zeros must fill excess spaces.)

## SET OPERATING MODE

As shown in TABLE 1, the command SET OPERATING MODE must be followed by an ASCII string which describes the mode. The list of valid SET OPERATING MODE commands along with valid abbreviations are listed below:

SET OPERATING MODE CONCENTRATION (ret)  
S O M C (ret)

SET OPERATING MODE MAX HOLD (ret)  
S O M M H (ret)

## SET REAL TIME

The format for setting the real time is as follows:

II / II / II IIII  
.....  
..... minutes (max = 59)  
..... hours (max = 23)  
..... year  
..... day  
..... month

For example: SET REAL TIME 02 / 15 / 86 1723 (ret)

This instructs the 580B to set its real time clock to February 15, 1986 5:23 p.m.

## SET USER ID

The user ID is a string of 9 integers. To set user ID = 66, use the following command "SET USER ID 000000066 (ret)" (leading zeros must fill in excess spaces).

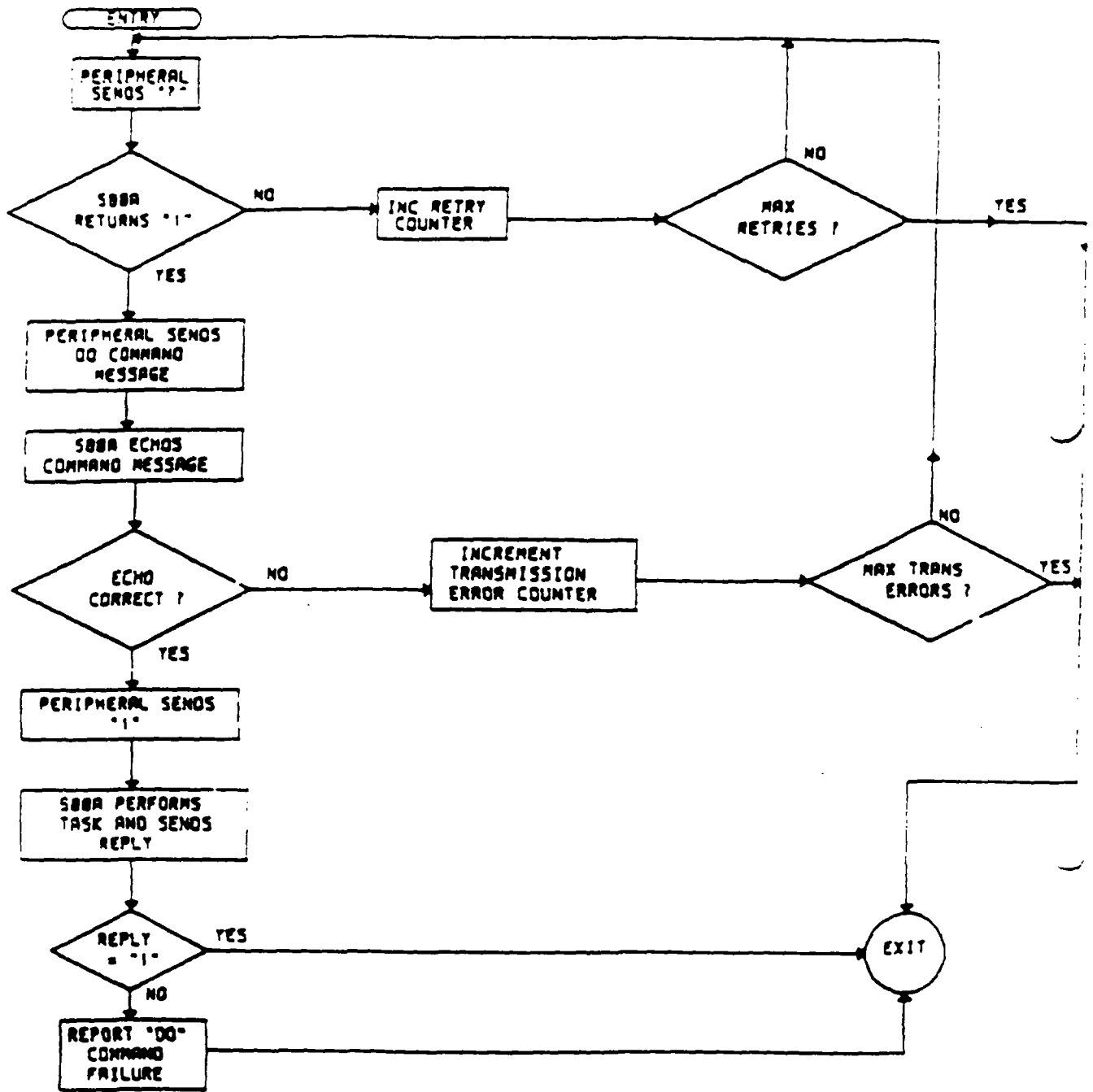


FIGURE 1  
SOFTWARE HANDSHAKE  
DO COMMANDS

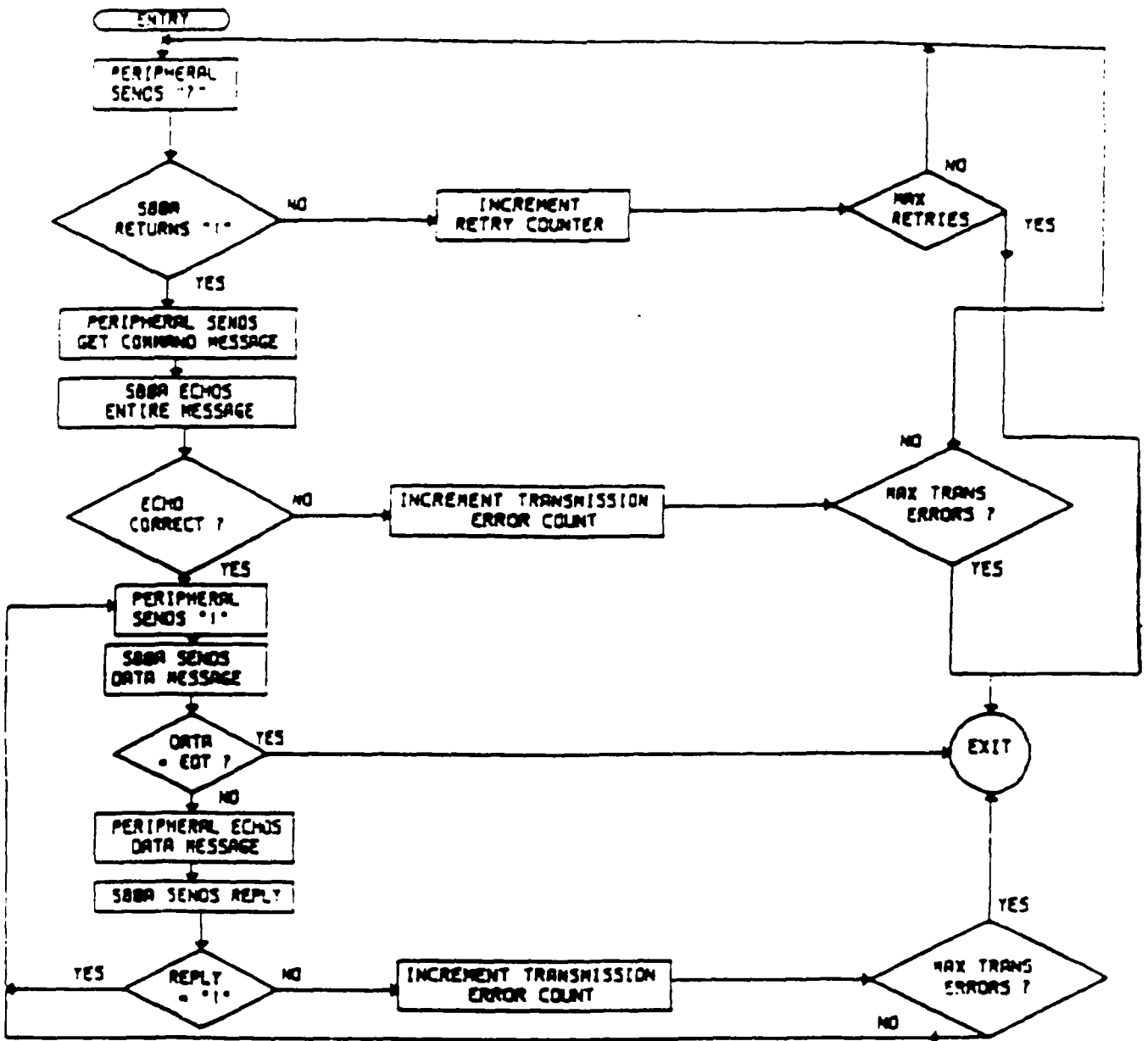


FIGURE 2  
SOFTWARE HANDSHAKE  
GET LOG DATA, GET CONTINUE LOG COMMAND

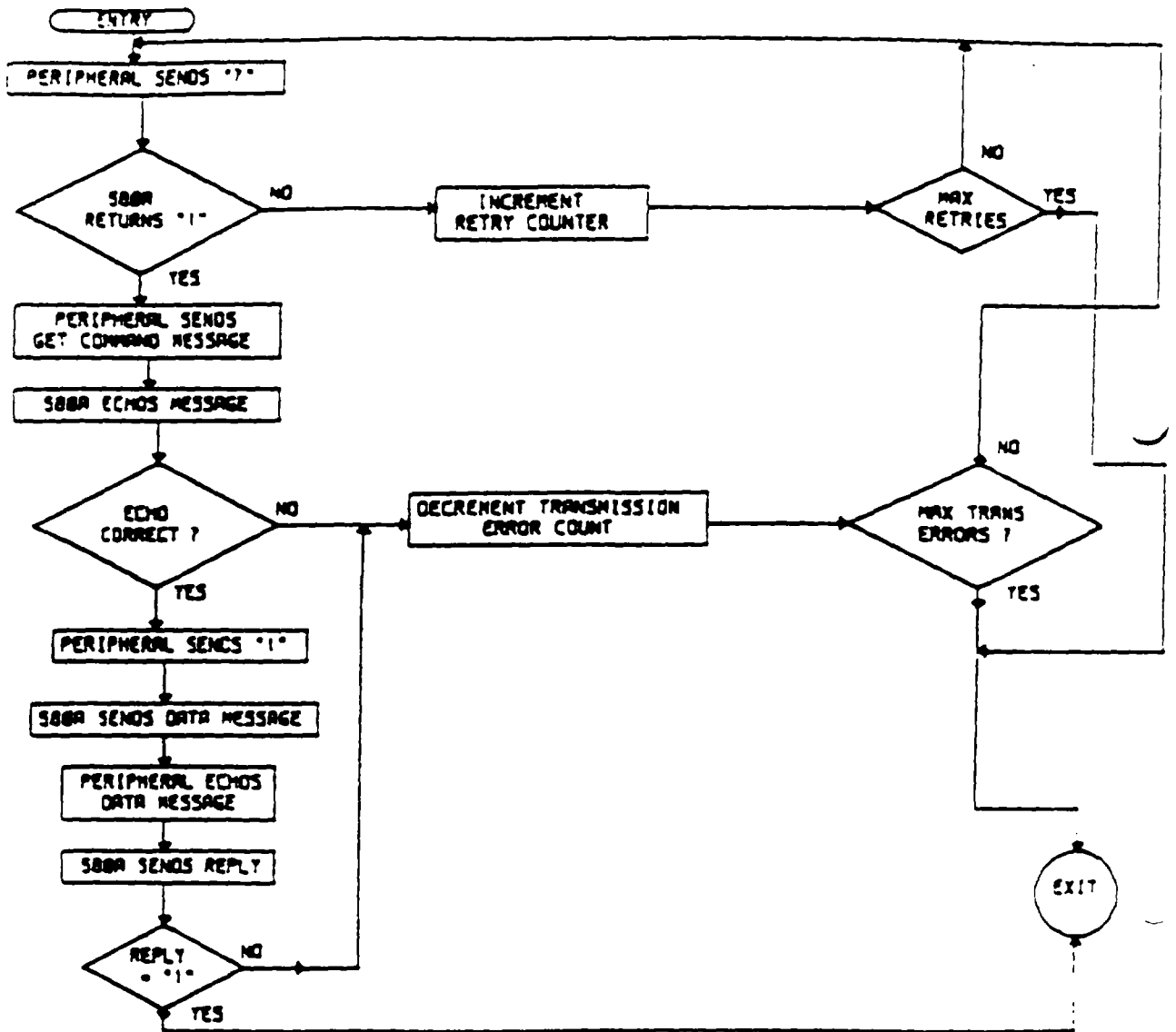


FIGURE 3  
 SOFTWARE HANDSHAKE  
 GET COMMAND  
 (EXCEPT GET LOG DATA, GET CONTINUE LOG)



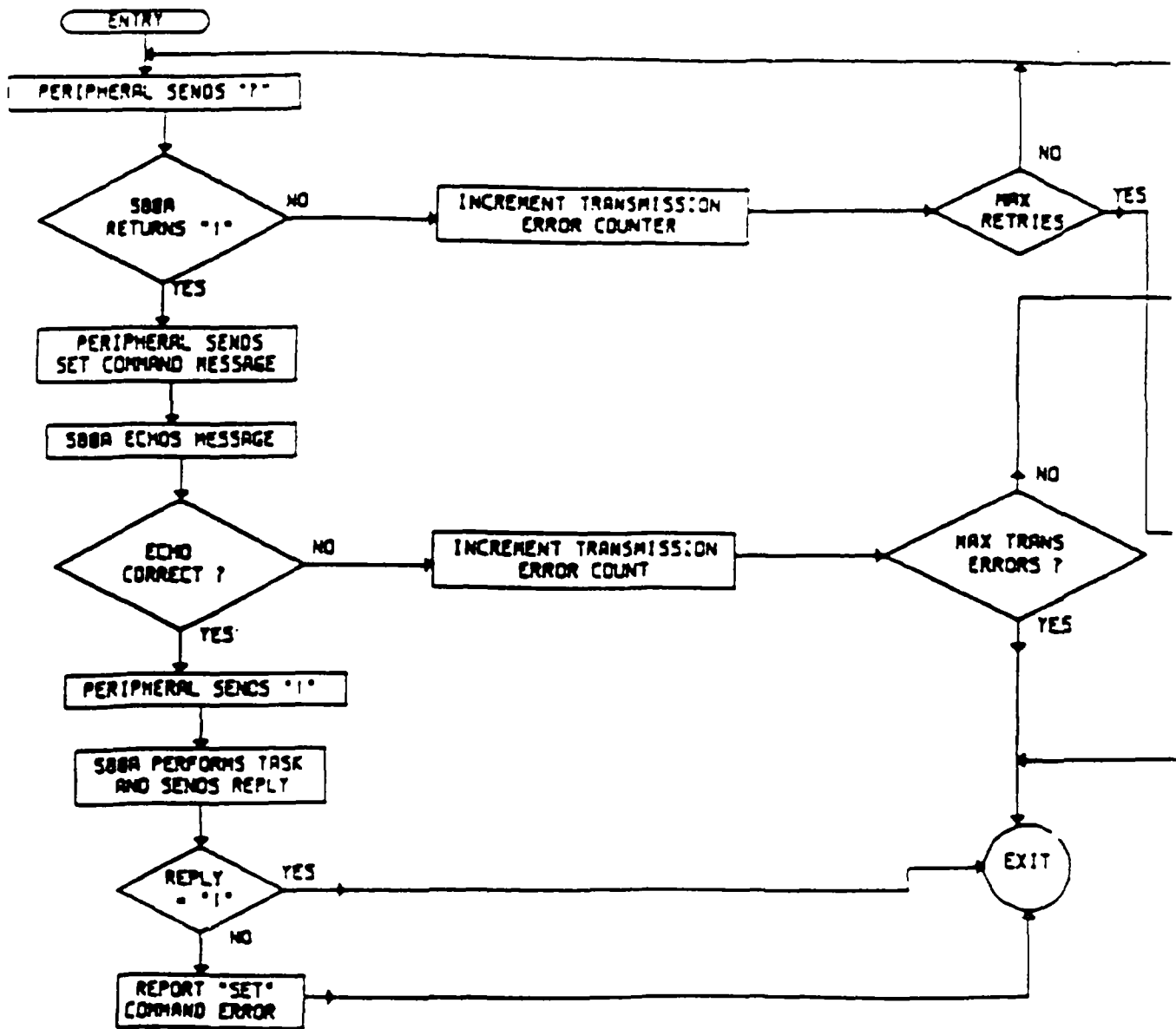


FIGURE 4  
SOFTWARE HANDSHAKE  
SET COMMANDS

580B VER. 1.1  
 07/11/88 1508  
 INSTRUMENT # 580000  
 USER I.D. # 014569373  
 OPERATING MODE: CONC. METER. MAX HOLD

		LOC.	PPM	STATUS		
07	11	88	1508	000000	0012	
07	11	88	1508	000001	0047	
07	11	88	1508	000002	0000	
07	11	88	1508	000003	0050	
07	11	88	1508	000004	0021	
07	11	88	1508	000005	0010	
07	11	88	1509	000006	0061	
07	11	88	1509	000007	0046	
07	11	88	1509	000008	0004	
07	11	88	1509	000009	0104	ALARM
07	11	88	1509	000010	0076	

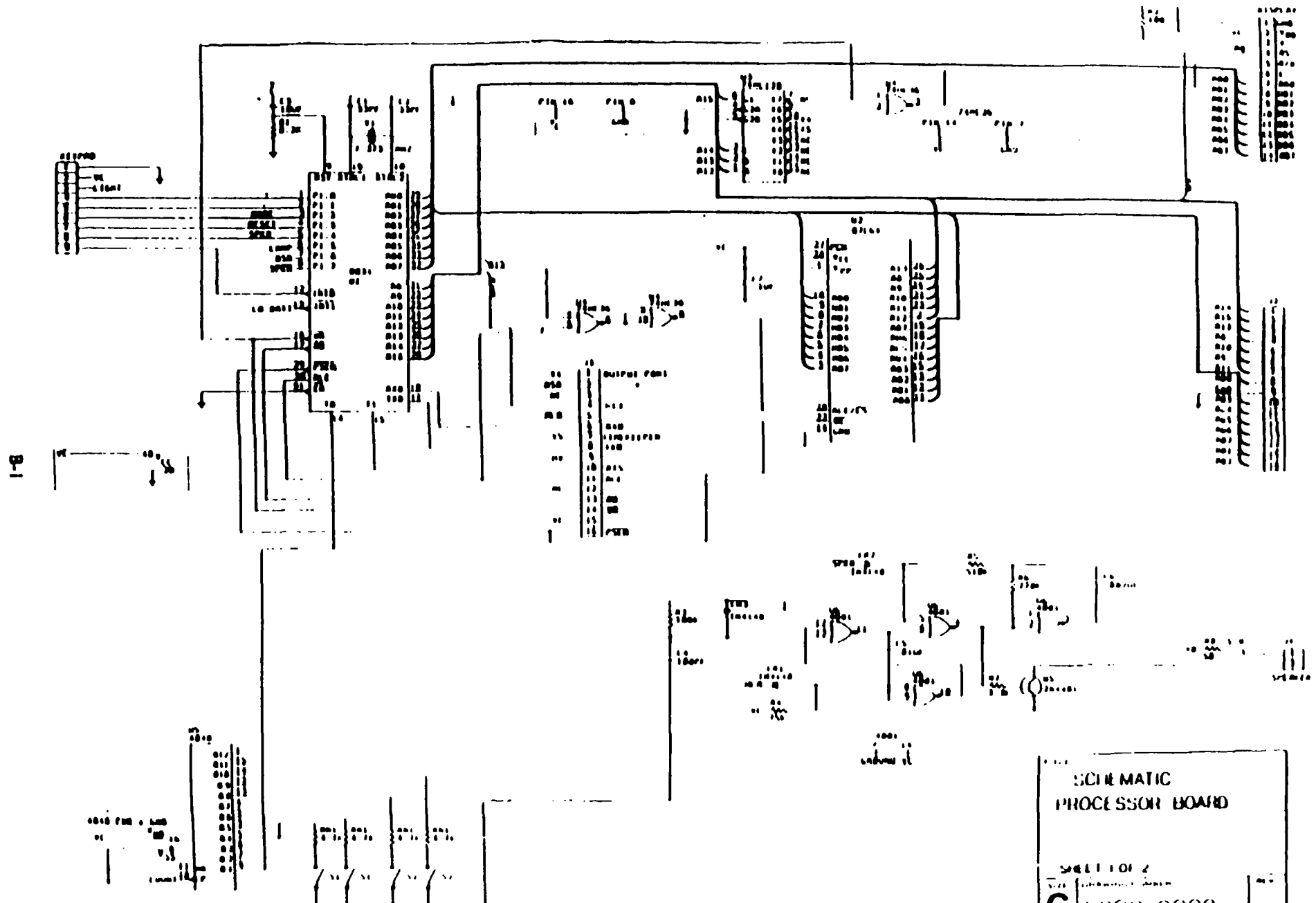
07/11/88 1509  
 INSTRUMENT # 580000  
 USER I.D. # 014569373  
 OPERATING MODE: CONC. METER

		LOC.	PPM	STATUS		
07	11	88	1509	000011	0000	
07	11	88	1509	000012	0064	
07	11	88	1509	000013	0052	
07	11	88	1509	000014	0001	
07	11	88	1509	000015	0007	
07	11	88	1509	000016	0101	ALARM

07/11/88 1510  
 INSTRUMENT # 580000  
 USER I.D. # 014569373  
 OPERATING MODE: CONC. METER. MAX HOLD

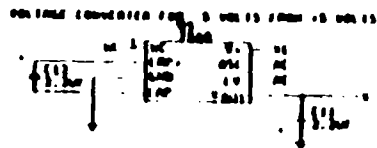
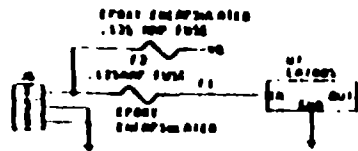
		LOC.	PPM	STATUS		
07	11	88	1510	000017	0012	
07	11	88	1510	000018	0023	
07	11	88	1510	000019	0108	ALARM
07	11	88	1510	000020	0084	

FIGURE 5  
 DATA LOG OUTPUT

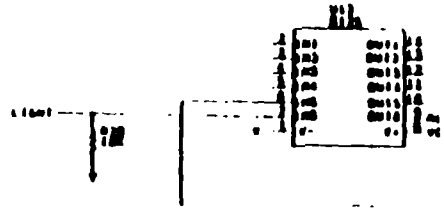


1-8

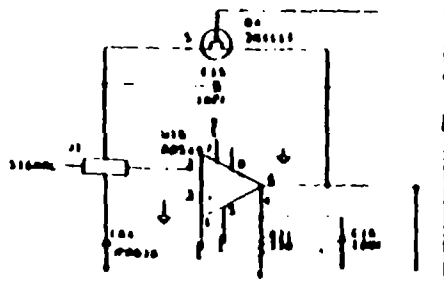
SCHEMATIC PROCESSOR BOARD	
SHEET 1 OF 2	
C 5805 9002	



B-2



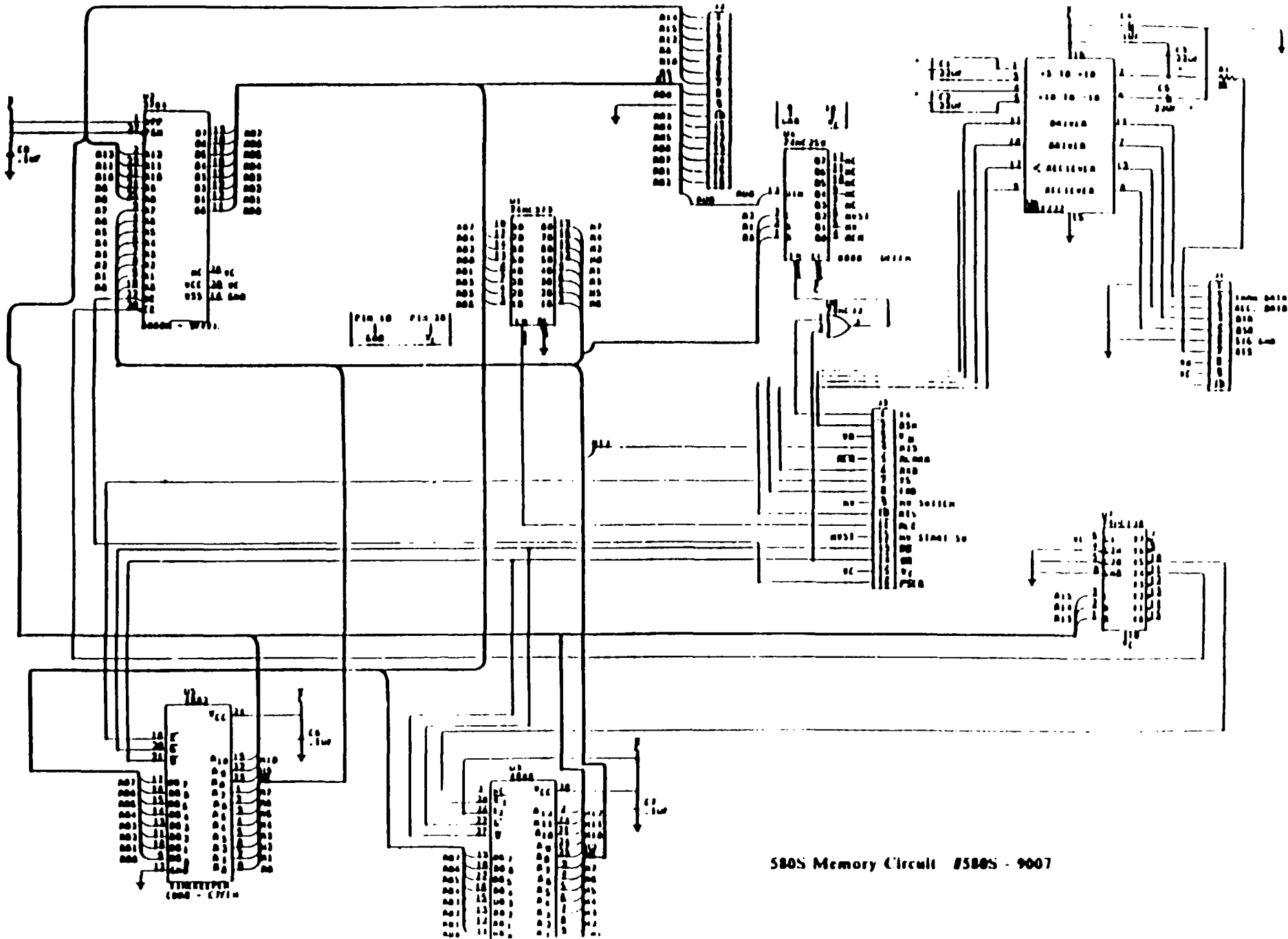
NOTE: 100K CAP. SHOULD BE ADDED AND SOLDERED DIRECTLY TO THE STRAP.



**SCHEMATIC  
PROCESSOR BOARD**

SHEET 2 OF 2

C 580S-9002



580S Memory Circuit #580S - 9007

QUAN.	PART NUMBER	DESG.	DESCRIPTION
2	10391	C1 C2	CAPACITOR.33PF.
1	0160-0059	C5	CAPACITOR..01UF.
3	0160-0060	C3 C13 C16	CAPACITOR.10UF.
2	10390	C11 C12	CAPACITOR. 2.2UF
1	0160-0063	C4	CAPACITOR.100PF.
1	0160-0056	C7	CAPACITOR..1UF.
1	0160-0066	C15	CAPACITOR.18PF.
1	10384	C6	CAPACITOR..002UF.
2	10386	C17 C18	CAPACITOR.200PF.
1	10446	J1	RIGHT ANGLE SMC COAX - RADIALL
1	0410-0005	Y1	CRYSTAL. 7.373 MHZ
1	0698-3029	R21	RESISTOR.330.
1	5983	R25	RESISTOR.3K.
1	0698-3033	R1	RESISTOR.8.2K.
1	5986	R7	RESISTOR.3.3K.
1	0757-0002	R2	RESISTOR.100.
2	0698-0097	R30 R9	RESISTOR. 100. 1/2 W
2	0757-0013	R18 R19	RESISTOR.33K.
2	0757-0015	R28 R29	RESISTOR.15K.
1	0757-0017	R3	RESISTOR.100K.

QUAN.	PART NUMBER	DESG.	DESCRIPTION
1	0757-0018	R22	RESISTOR.1K.
1	10938	R8	RESISTOR. 50. 5 WATT
1	0757-0019	R12 R13 R14 R17 R20 R26 R27	RESISTOR.10K.
1	0757-0083	R4	RESISTOR.75K.
1	0757-0084	R5	RESISTOR.510K.
1	0757-0085	R6	RESISTOR.270K.
1	10938	R15	RESISTOR.68K.
1	8287	R16	RESISTOR.39K.
1	10935	R23	RESISTOR.20K.
1	10936	R24	RESISTOR.2K.
1	0950-0094	U3	74HC138 - H-CMOS 3/8 DECODER
1	1251-0127	J4	CONNECTOR..100 CENTER 2 POS.
1	1251-0134	J7	CONNECTOR..156 CENTER 2 POS.
1	11418	J5	CONNECTOR. 4 POS AMP MTE HEADER
1	11419	J6	CONNECTOR.2 POS AMP MTE HEADER.
1	11641	RN1	RESISTOR.4.7K.
1	1820-0049	U9	ICL7660 - VOLTAGE CONVERTER
1	1820-0050	U1	80C31 - 8-BIT MICROCONTROLLER
1	1820-0051	U5	4040 - CMOS 12-STAGE BINARY COUNTER
1	1820-0052	U6	4001 - CMOS QUAD 2-INPUT NOR GATE
1	1820-0054	U4	74HC36 - QUAD NOR
1	1820-0055	U12	D125 - HEX FET DRIVER

**BILL OF MATERIALS**  
580S-6000

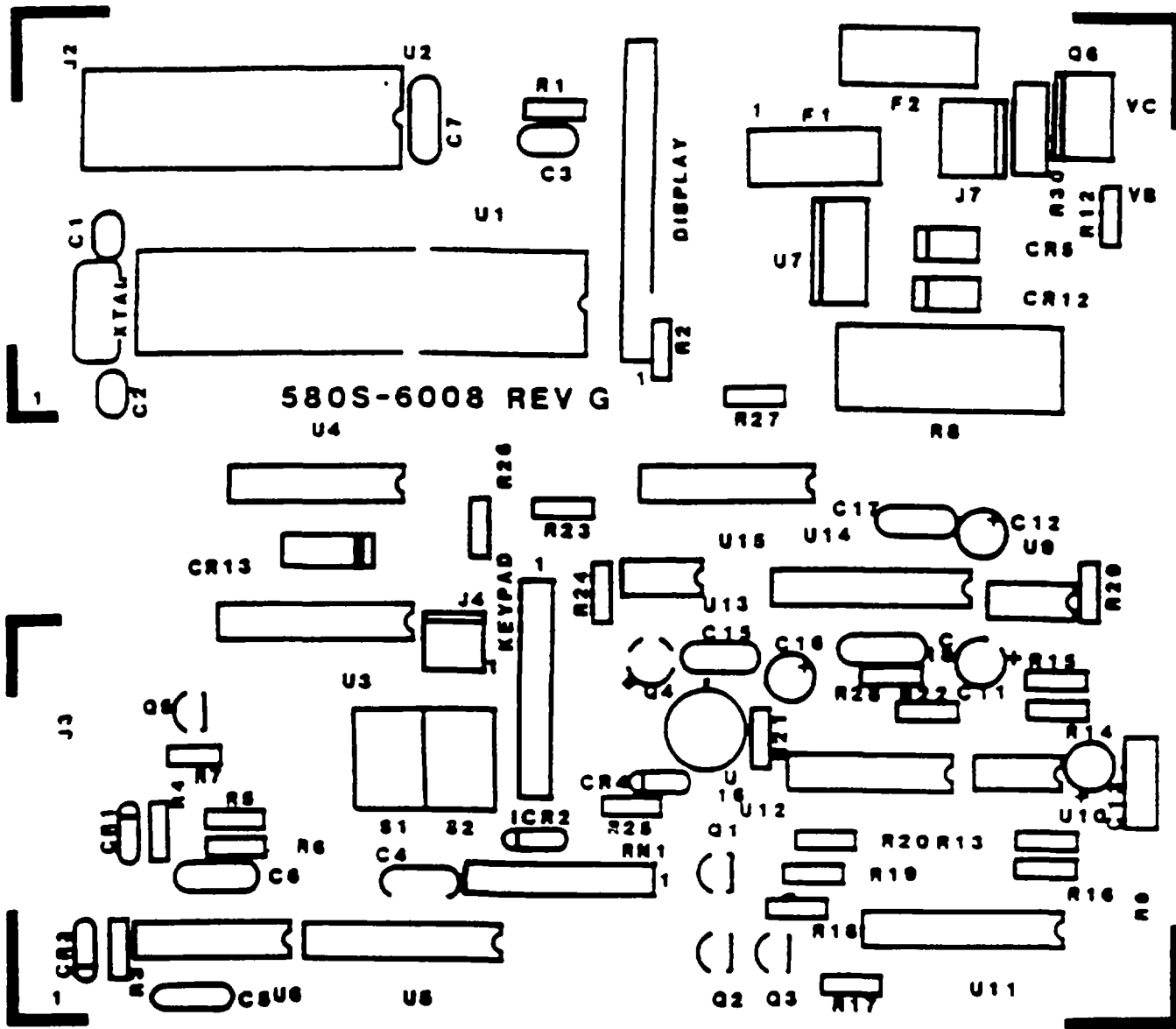
**THERMO ENVIRONMENTAL INSTRUMENTS**

PAC

QUAN.	PART NUMBER	DESC.	DESCRIPTION
1	1820-0060	U16	AD549 - MONOLITHIC ELECTROMETER
1	1820-0062	U2	87C64 - 8K CMOS EPROM
1	0950-0069	U7	LM7805CT - 5 VOLT REGULATOR
1	11714	U13	CA3290A - BIMOS DUAL VOLTAGE COMPARATOR
1	11716	U10	LM2904 - DUAL OP AMP
1	11717	U11	CD40109B - CMOS QUAD L-H VOLT LEVEL SHIFTER
1	11718	U14	CD4538 - DUAL CMOS ONE-SHOT
1	11719	U15	4011 - CMOS QUAD 2-INPUT NAND GATE
1	1854-0013	Q5	NPN TRANSISTOR, 2N4401
1	1854-0014	Q4	N-CHANNEL J-FET, 2N4117
3	11762	Q1 Q2 Q3	PNP TRANSISTOR, 2N4403
1	1855-0007	Q6	N-CHANNEL J-FET, 1RF523
1	1901-0006	CR13	DIODE, 1N5820
3	1901-0008	CR1 CR2 CR3	DIODE, 1N4148
1	11825	CR4	DIODE, 1P4D20
2	11828	CR5 CR12	ZENER, 1N5339, 5.6V, 5 W
2	3100-0037	S1 S2	SWITCH, SPST
2	580S-6040	F1 F2	.125 AMP FUSE WITH EPOXY COATING

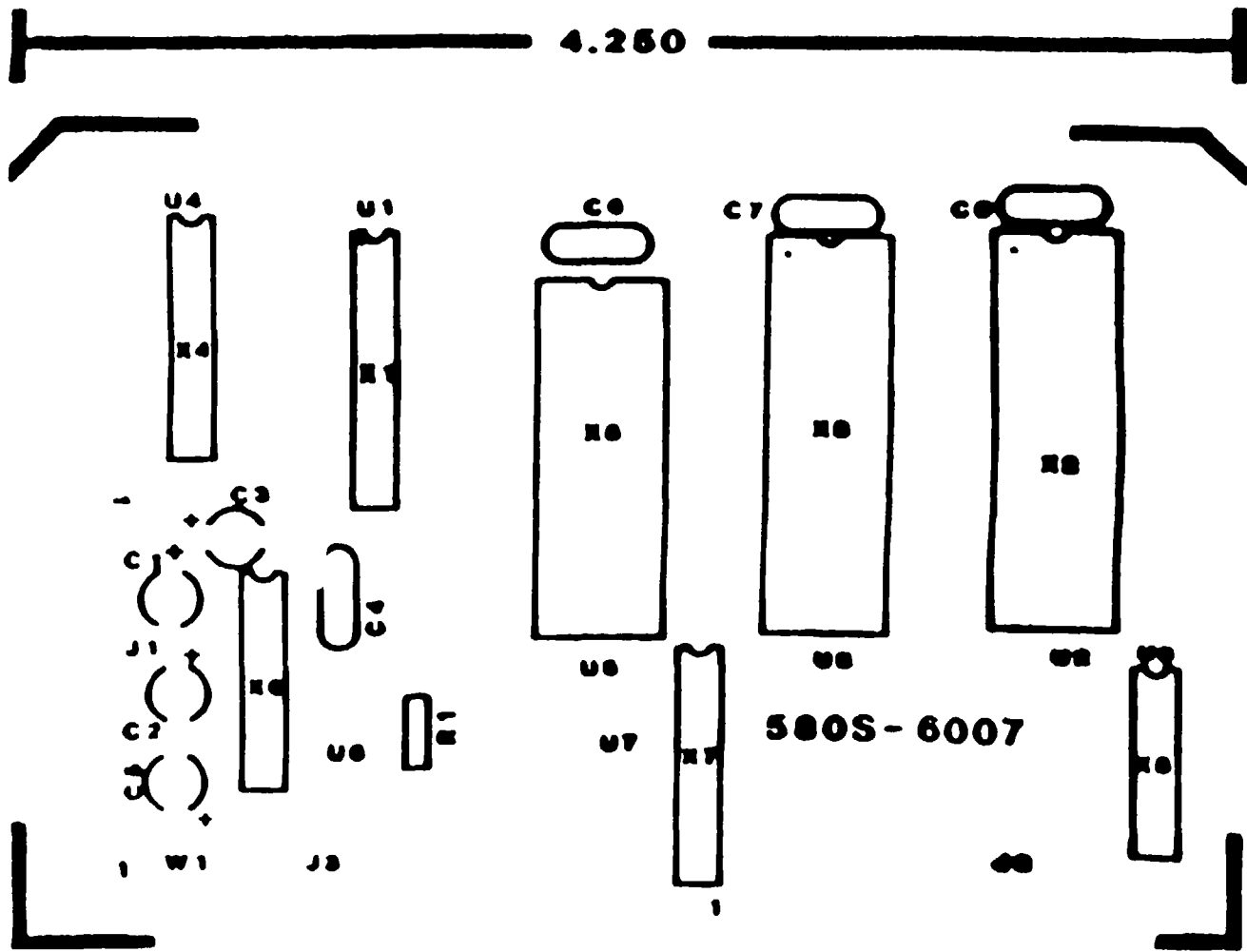


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580S-6008 REV G

QUAN.	PART NUMBER	DESG.	DESCRIPTION
1	1820-0044	U1	74HC373
1	1820-0045	U2	27C64 — 8K EPROM
1	1820-0042	U3	48Z08 — 8K x 8 BATTERY BACKED RAM
1	1820-0043	U4	74HC259 — OUTPUT PORT
1	1820-0046	U5	48T02 — 2K x 8 TIMEKEEPER RAM
1	1820-0040	U6	MAX232 — RS-232 CHIP
1	0950-0094	U7	74HC138
1	1820-0005	U8	74HC32
4	0160-0062	C1 C2 C3 C5	CAPACITOR. 1 uF
4	0160-0065	C4 C6 C7 C8	CAPACITOR. .1 uF
1	0698-3032	R1	RESISTOR. 3K
A/R	9120-0004		CABLE — 4 CONDUCTOR



580S-6007

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