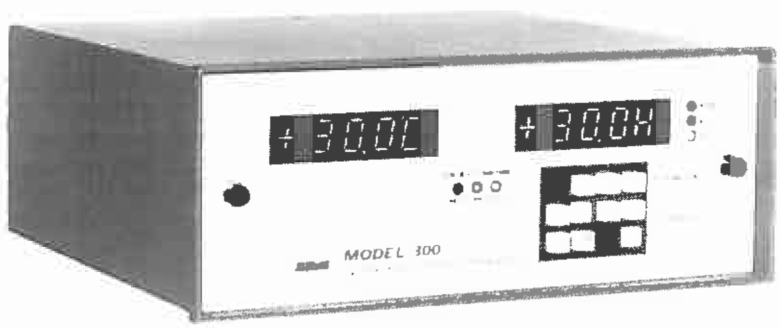
MODEL 300

MICROPROCESSOR CONTROLLED HUMIDITY ANALYZER

INSTRUCTION MANUAL

P/N 119849



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CAUTION

This equipment generates, uses, and can radiate radio frequency energy, and, if not installed and used in accordance with the instruction manual, may cause interference to radio communications. As temporarily permitted by regulation, it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

NOTE: This instrument is designed to operate on either 115 or 230 VAC. Read the "**Preparation for Operation**" section on page 3-1 of this manual before plugging instrument into source of AC power.

WARRANTY STATEMENT

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We want you to be entirely satisfied with your instrument. The information in this manual will get you started. It tells you what you need to get your equipment up and running, and introduces its many features.

We always enjoy hearing from the people who use our products. Your experience with our products is an invaluable source of information that we can use to continuously improve what we manufacture. We encourage you to contact or visit us to discuss any issues that relate to our products or your application.

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EG&G
MOISTURE AND HUMIDITY SYSTEMS

Introduction

1.1 GENERAL DESCRIPTION

The Model 300 Microprocessor Controlled Humidity Analyzer (Figure 1-1) is designed to measure moisture in gases for a wide variety of laboratory and industrial applications. This instrument is a portable AC line operated hygrometer which utilizes the chilled mirror dew point condensation principle to determine the water vapor concentration in gas mixtures. A 3-1/2 digit LED digital display with a descriptive character digit for presenting the dew point temperature and other optional outputs is provided on the front panel for ease of viewing.

The Model 300 Microprocessor Controlled Humidity Analyzer is designed to allow several options and accessories to be easily attached to the basic instrument, thereby expanding its capabilities. An output connector for attaching external recording or monitoring equipment is provided at the rear panel of the instrument. The Model 300 Microprocessor Controlled Humidity Analyzer can be equipped with an optional Model 300-AT Ambient Temperature Kit and an optional Model 300-RH COMP™ computer to provide front panel display and analog outputs corresponding to the relative humidity of the gas being sampled. Other programs are available or can be generated to provide special outputs in other engineering units such as Grains, PPM_v, and Moisture Ratio.

The Model 300-S3 Sensor can be mounted directly to the instrument cover on the rear panel (Figure 1-2a), where it will be cooled by the instrument fan or by use of an external liquid coolant supply, or it may be detached from the instrument cover (Figure 1-2b) and allowed to operate by attaching it to an external heat sink or by using an external liquid cooling supply. An optional Model 300-RK Remote Mounting Kit is also available for those applications that require the sensor to be located up to 150 meters (500 feet) from the control unit.

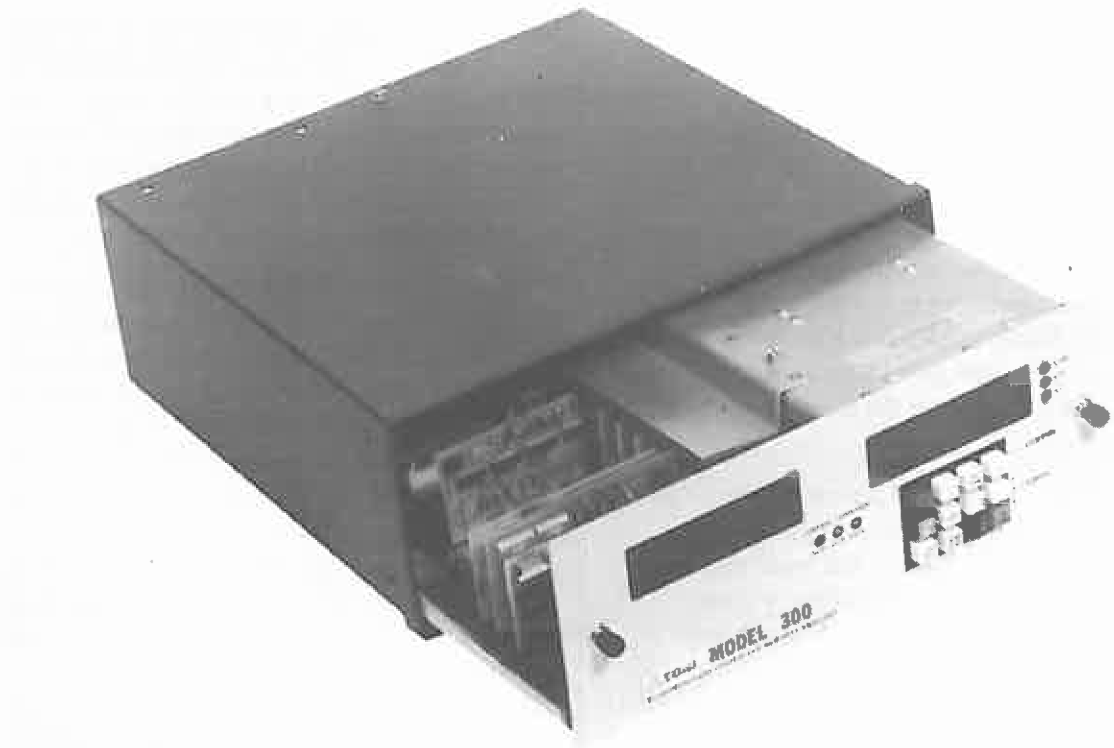
The Model 300-S3 Sensor employs a mirror surface for the primary or wet mirror. This mirror is manufactured with EG&G's new, proprietary, inert NEBS™ (Nickel Electroplate Based Surface) material which has (1) a bright, hard surface to provide superior corrosion and abrasion resistance, and (2) an inherent anti-wetting characteristic to enhance dew and frost formation. A secondary or dry mirror is also provided to serve as a reference or calibrate channel for the microprocessor controlled dew point control system.

A major feature of the Model 300 Microprocessor Controlled Humidity Analyzer is the application of microprocessors and digital techniques to control the servo loop that maintains dew or frost in equilibrium on the mirror surface in the sensor. These techniques allow the Model 300 to automatically compensate for such adjustments as gain, thickness, and compensation, keeping them at optimum levels regardless of the operating point. Also, the microprocessor is configured to monitor and control not only on the primary mirror system but also to monitor a secondary dry mirror system to automatically compensate the primary mirror system for changes in mirror reflectivity caused by particulate matter buildup, changes in receiver sensitivity, or changes in other factors that are common to both mirror systems. This feature enables this instrument to operate continuously without experiencing periodic balancing cycles characteristic of other hygrometers having automatic balancing capabilities. Prior to the time when the instrument will no longer compensate, an alarm signal and front panel light activate to alert the instrument operator that the sensor optical components and mirror surfaces should be cleaned, thereby eliminating possible significant instrument errors.

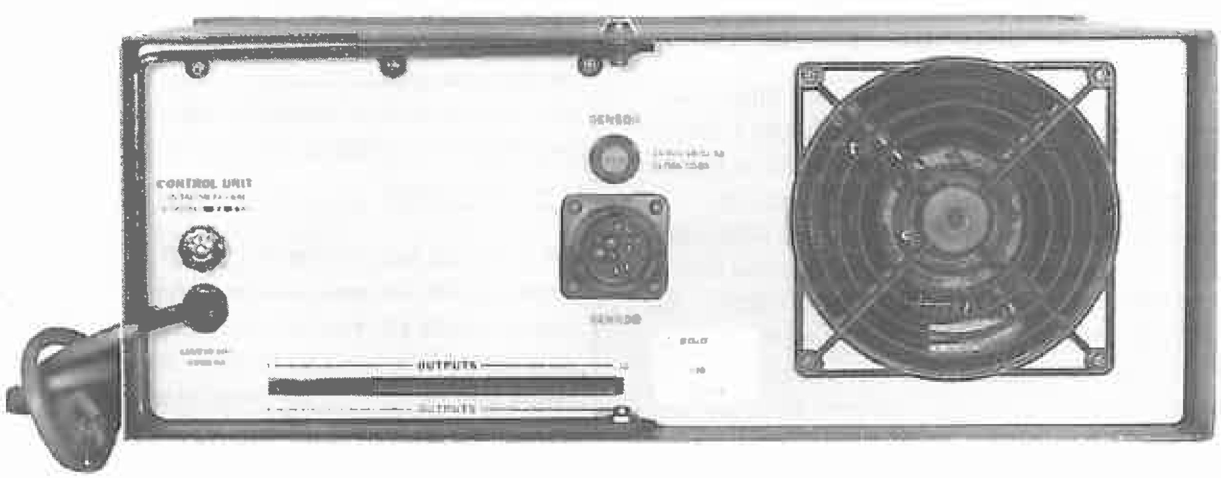
1.2 OPTIONS AND ACCESSORIES

Options and accessories designed to provide system expandability to meet a wide variety of application requirements are available for the Model 300 Microprocessor Controlled Humidity Analyzer. The options, when purchased with the basic Model 300, are installed at the factory prior to shipment. They may also be installed in the field at any time. Model 300 Accessories are always shipped separately and are installed in the field.

Introduction



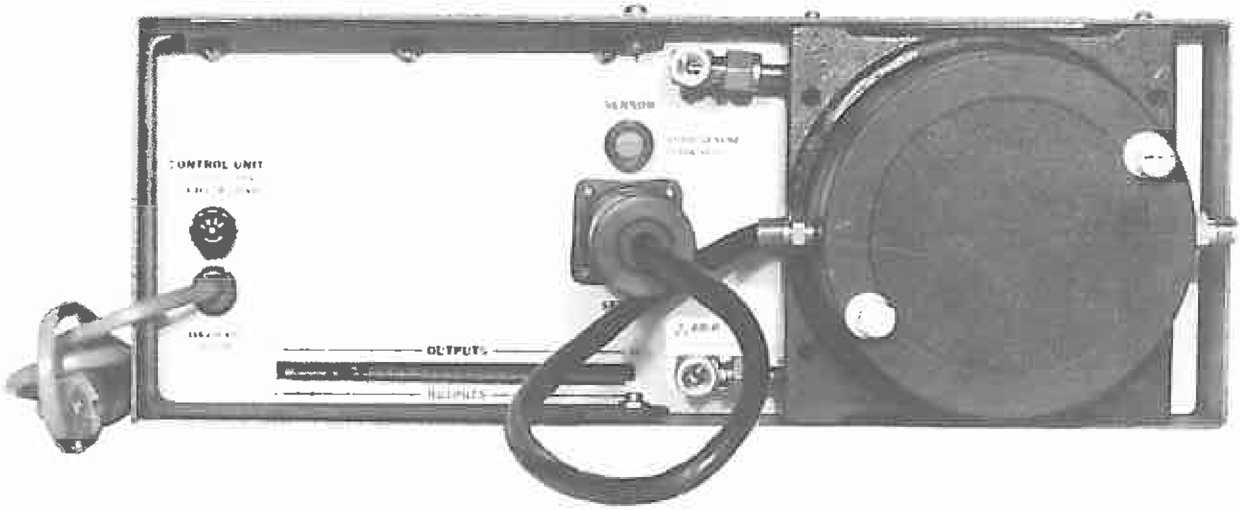
a. Front with interior partially exposed.



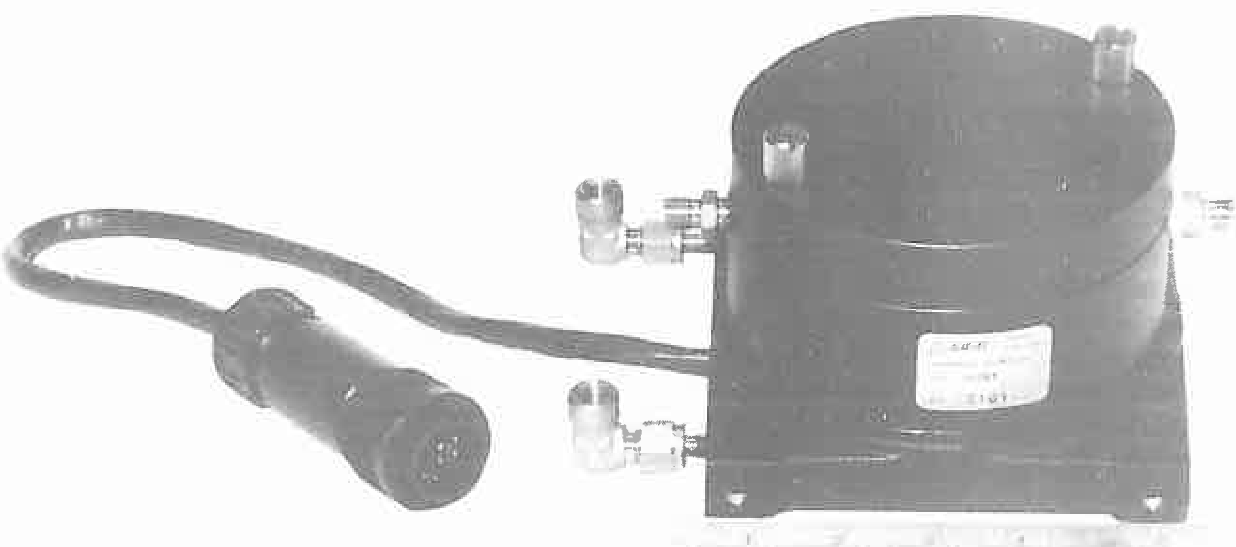
b. Rear Panel.

Figure 1-1. Model 300 Microprocessor Controlled Humidity Analyzer.

Introduction



a. Sensor mounted on instrument cover rear panel.



b. Sensor detached from instrument cover.

Figure 1-2. Model 300-S3 Sensor.

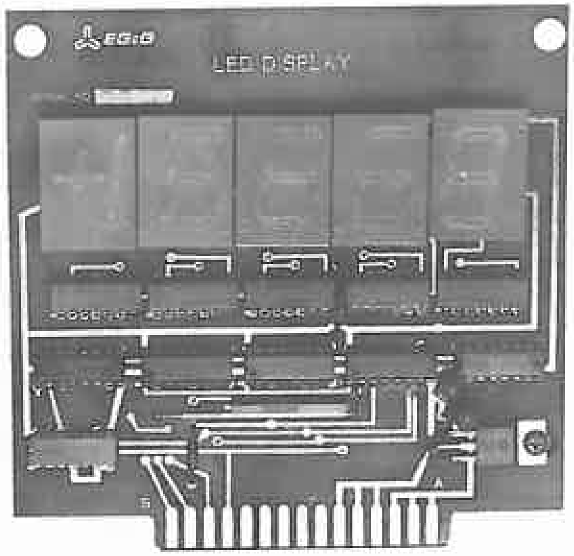


Figure 1-3. Model 300-RD Readout Display Option.

1.2.1 Model 300-RD Readout Display Option (Figure 1-3)

The basic Model 300 output display is switchable to allow display of any of the outputs generated by the Model 300, whether from the basic unit or from certain optional attachments. However, when the Model 300 is equipped with options or accessories that generate additional outputs and it is desired to display any two of the outputs on the front panel simultaneously, then this option is utilized. This option consists of a Printed Wiring Board (PWB) that contains the necessary electronics and digital displays comparable to the basic display. This option will display either dew point data or ambient temperature data, as selected by a switch located on the MUX and ADC PWB located within the instrument. Addition of this option has no effect on the standard switchable display. This option plugs into the main PWB directly behind the front panel, and is secured by two screws (provided).

1.2.2 Model 300-CF Degree Fahrenheit Readout Capability Option (Figure 1-4)

This option consists of a plug-in circuit card that converts the normal basic degree Celsius analog outputs of the dew point and ambient temperature channels to the analog voltages equivalent to the comparable degree Fahrenheit range. This allows for Fahrenheit degrees to be displayed on the front panel for user convenience. A special character digit, associated with both the standard display and the optional Model 300-RD second display, indicates either °C or °F to identify the temperature scale selected for display. Selection is accomplished by appropriate selection of certain rocker switches (S2) on the main PWB. Analog outputs at the rear panel connector corresponding to both Celsius and Fahrenheit outputs appear simultaneously when this option is provided.

1.2.3 Model 300-BC BCD Output Module Option (Figure 1-5)

When fully latched, parallel, T²L compatible outputs are required for external data monitoring or data logging; this plug-in circuit card option can be utilized. A switch on the BCD PWB can select either dew point or ambient temperature data for conversion to the parallel latched BCD form and presentation at the output connector. A rocker switch (S2) on the main PWB allows for selection of the output of the Model 300-RH COMP™ Computer Card to be converted to parallel latched BCD form. The output data provided corresponds to the data provided for the front panel

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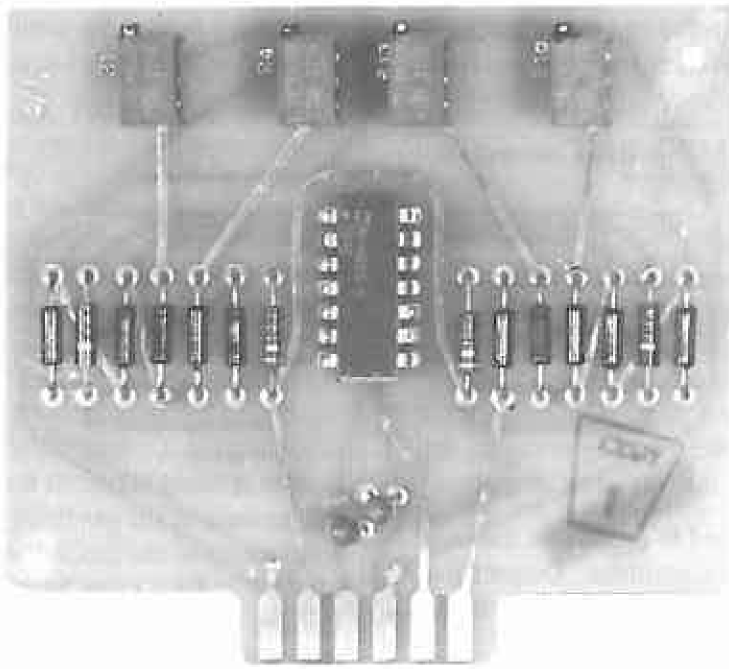

Figure 1-4. Model 300-CF Degree Fahrenheit Readout Capability Option.

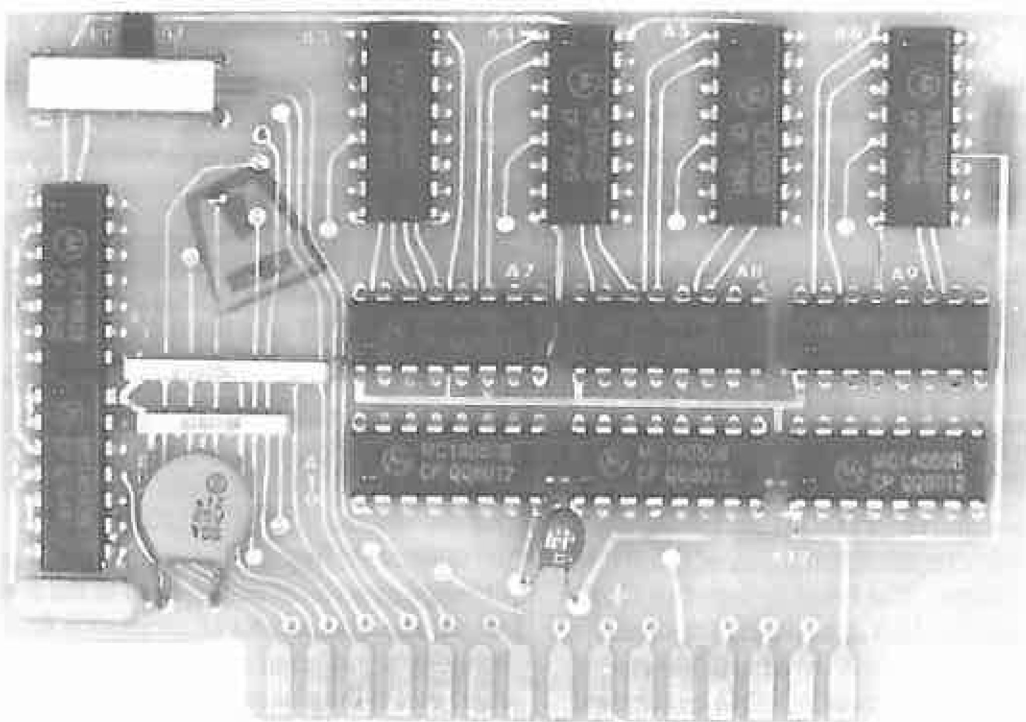

Figure 1-5. Model 300-BC BCD Output Module Option.

displays for the parameter selected and represents 3-1/2 digits of information plus a polarity indicator and data update strobe.

1.2.4 Model 300-RH COMP™ RH Computer Option (Figure 1-6)

This option consists of a plug-in circuit card that accepts two channels of input data--normally dew point and ambient temperature--generated by the Model 300 and then processes these data for presentation to the front panel display. The calculated data are selected for display by controls on the front panel switch matrix. In addition, an analog output corresponding to the digital data displayed is provided at the rear panel connector.

This option can be programmed to operate on the input data in accordance with most algorithms. Outputs that can be provided for data presentation in engineering units include, but are not limited to, %RH, PPM_v, Grains, and Humidity or Moisture Ratio. For special analog, milliampere, and alarm outputs, consult the factory for details.

For presentation of calculated data outputs that are too large to be displayed directly in the standard 3-1/2 digit display, three multiplier lights are provided on the front panel. The number in the display should always be multiplied by the multiplier (X1, X10, X100) when displaying the results of calculations by the RH COMP™.

1.2.5 Model 300 Pressure Transducer Option

This option consists of a Setra Model 205-2 Pressure Transducer and a Pressure Interface Card. The pressure range for the transducer is customer-specified. The Pressure Interface Card is custom adjusted to the specified pressure range.

When pressure correction to PPM_v or Grains output of the CALCOM board is required, a transducer is selected from the available ranges. The Pressure Interface Card is required to convert the 0-5 volts output of the transducer to a signal compatible with the Model 300 circuitry. Voltage to power the transducer can be supplied by the Model 300. Consult the factory for details. Wiring and installation information is provided in subsection 2.4.5.

1.2.6 Model 300-AT Ambient Temperature Accessory (Figure 1-7)

This accessory enables the Model 300 to measure and display the ambient temperature of the sample gas. It consists of a plug-in circuit card and a remote mounting Platinum Resistance Thermometer (PRT). The remote mounting PRT is equipped with 10 feet of interconnecting cable as standard; longer lengths up to 500 feet may be obtained upon request. The PRT should be placed so as to measure the temperature at the point that the sample is being taken. If it can be determined that the temperature of the gas being sampled is the same temperature as the gas in the gas lines connecting to the Model 300 Dew Point Sensor, then the Model 300-TF In-Line Temperature Sensor Mount may be used to mount the PRT in series with the sample lines. The PRT is designed with a 3/8-inch NPT male pipe fitting for mounting purposes.

1.2.7 Model 300-TF In-Line Temperature Sensor Mount Accessory (Figure 1-8)

This accessory consists of brass fittings configured to provide an in-line protective mount for the Model 300-AT Ambient Temperature Accessory. Sample line inputs and outputs are both female 1/8-inch NPT pipe threads and the Model 300-AT Platinum Resistance Thermometer (PRT) mounts in a 3/8-inch NPT pipe thread. Pipe thread sealer is also provided to aid in mounting the PRT into the fittings.

This accessory should be used only when it can be determined that the temperature of the gas in the sample lines is the same as the temperature at the point the gas sample is being taken. Otherwise, it is recommended that the PRT be located at the sample line inputs. While the moisture content of the sample gas is not affected by a change of ambient temperature in the sample lines, subsequent calculations of parameters such as relative humidity are affected and for this reason care should be exercised in the placement of the ambient temperature PRT.

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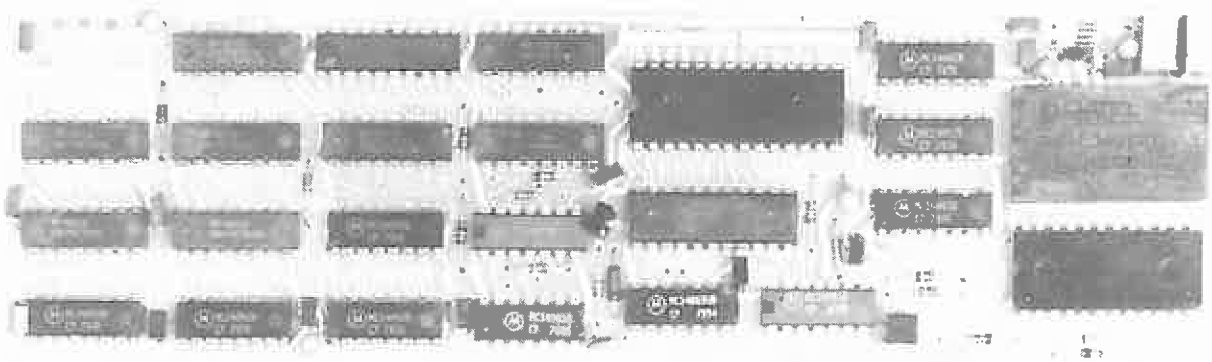

Figure 1-6. Model 300-RH COMP™ RH Computer Option.

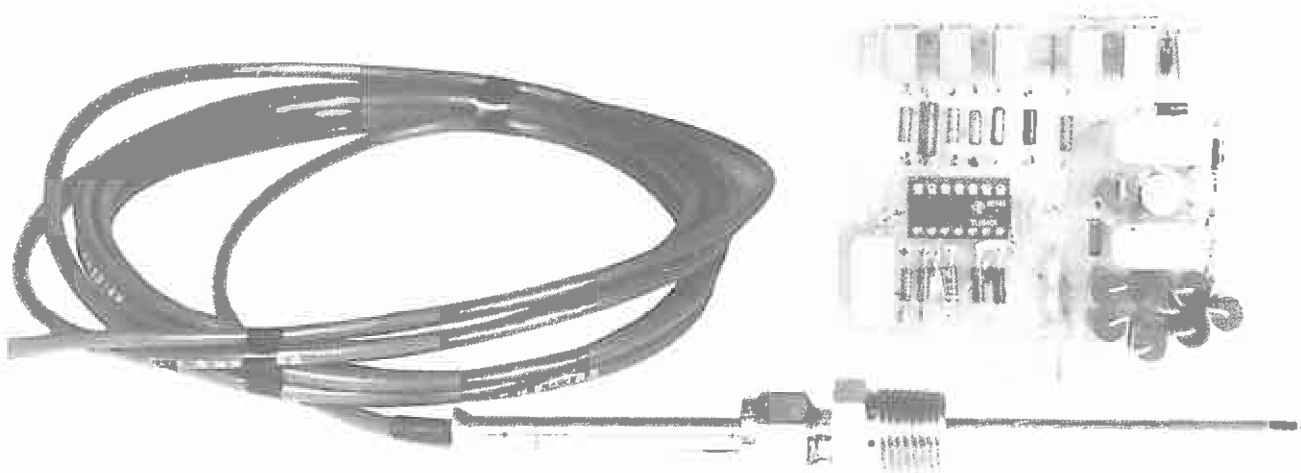

Figure 1-7. Model 300-AT Ambient Temperature Accessory.

Introduction

Figure 1-8. Model 300-TF In-Line Temperature Sensor Mount Accessory.

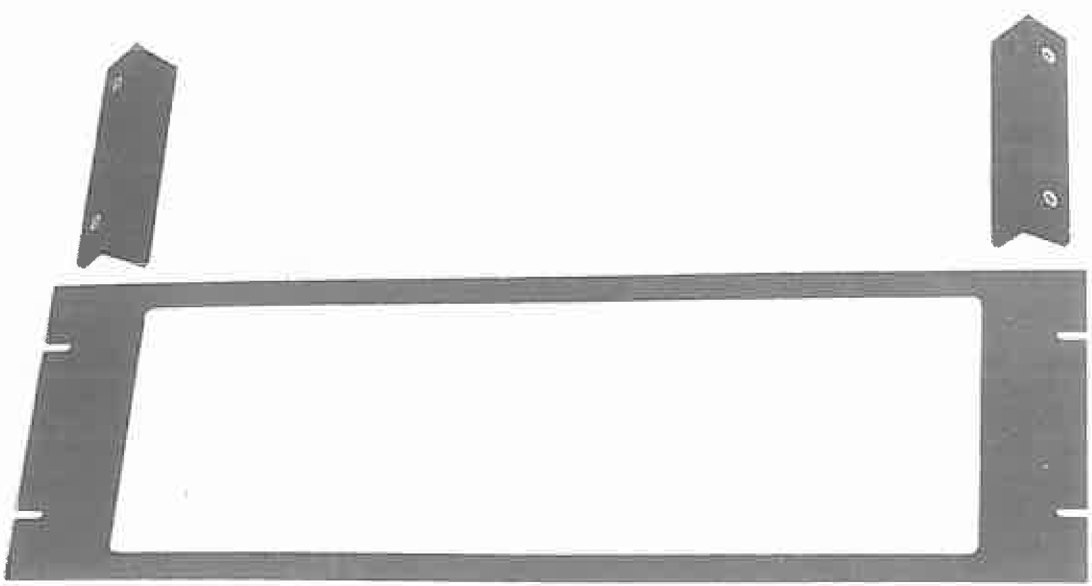

Figure 1-9. Model 300-PR Panel/Rack Mounting Kit Accessories.

1.2.8 Model 300-PR Panel/Rack Mounting Kit Accessories (Figure 1-9)

These accessories are used to mount the Model 300 in a panel or standard 19-inch rack. Common to both kits are two symmetrical brackets that attach to the sides of the Model 300 Control Unit. For panel mounting, a cutout is provided in the appropriate location in the panel and the Model 300 is inserted from the front. The brackets and jack screws serve to jack the brackets to hold the Model 300 Control Unit cover tight against the panel cutout. The lip on the Model 300 Control Unit cover also hides any rough edges of the panel cutout if present.

The rack mounting kit contains an additional piece of sheet metal designed for direct mounting in 19-inch wide racks. This metal piece already has the cutout required for inserting the control unit in a manner similar to that used for panel mounting.

1.2.9 Model 300-RC Remote Mounting Kit Accessory (Figure 1-10)

This accessory provides a cable with appropriate connectors to mount the Model 300-S3 Sensor remotely from the Model 300 Control Unit. The standard cable length is 3 meters (10 feet), although cable lengths up to 150 meters (500 feet) may be ordered.

1.2.10 Model 300-SS Sample System Kit Accessory (Figure 1-11)

This gas sampling system consists of a diaphragm pump, flow meter, and 8 feet of flexible polypropylene tubing with the necessary fittings to draw a gas sample through the Dew Point Sensor.

1.2.11 Model 300-M Mirror Microscope Accessory (Figure 1-12)

This accessory is attached to the Sensor optical section and allows direct visual observation of the direct (wet) mirror surface. The major purpose of this option is to determine if frost or supercooled dew is present on the mirror when operating at temperatues below 0°C.

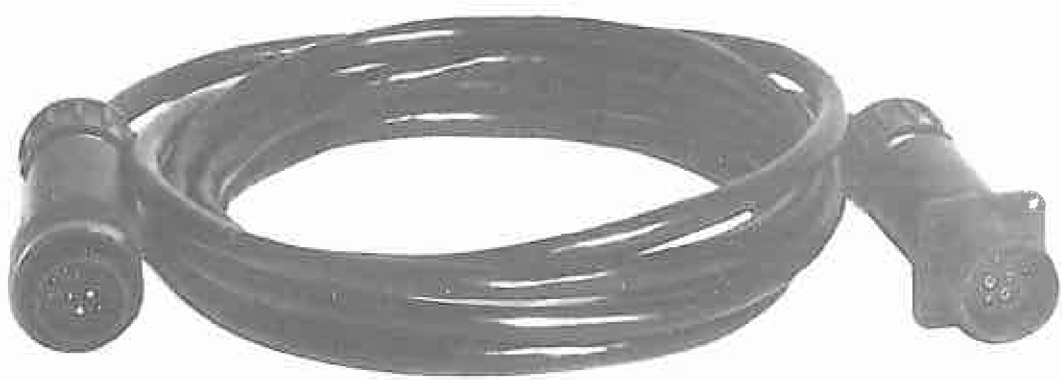

Figure 1-10. Model 300-RC Remote Mounting Kit Accessory.

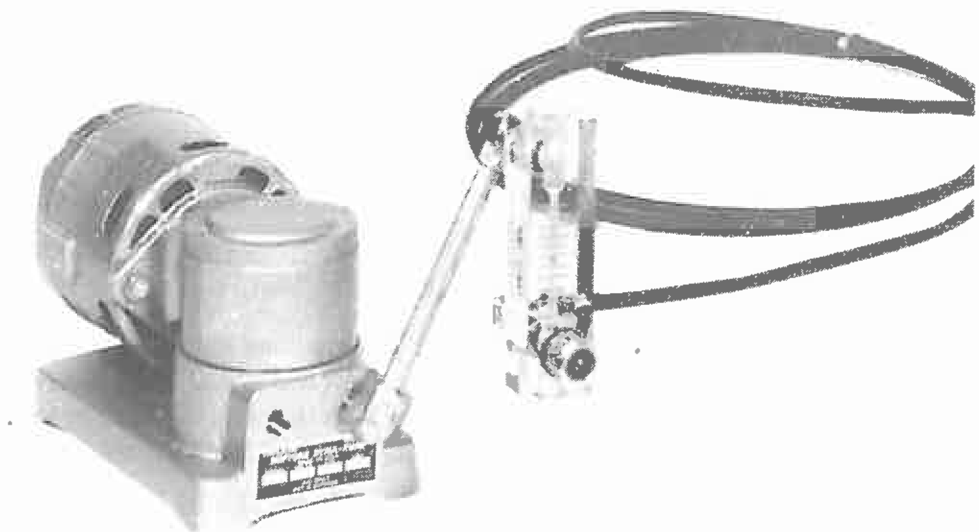

Figure 1-11. Model 300-SS Sample System Kit Accessory.

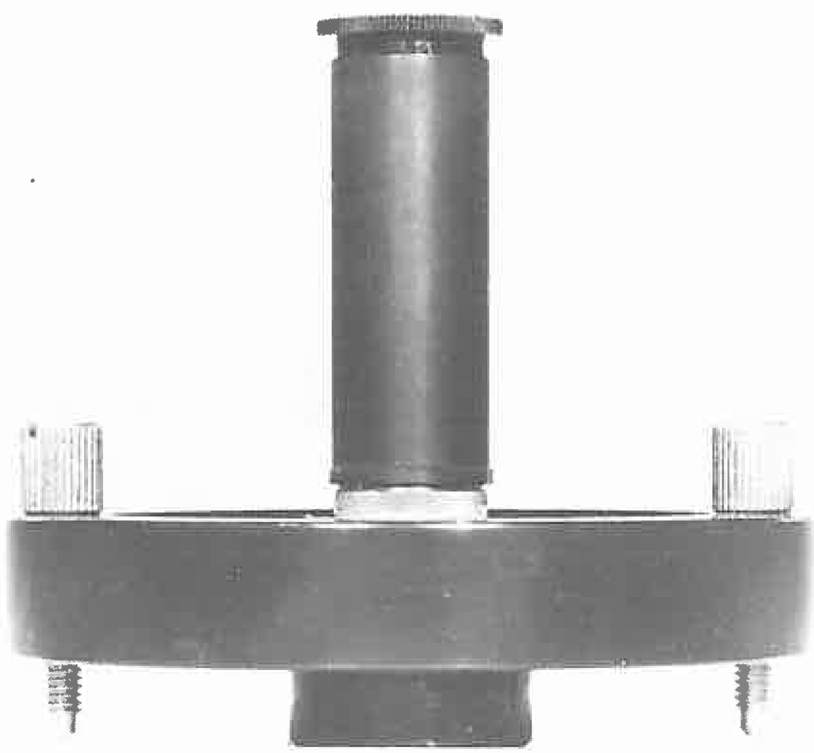

Figure 1-12. Model 300-M Mirror Microscope Accessory.

1.3 GENERAL SPECIFICATIONS

Dew Point Range	-75° to + 75°C (-100°F to +167°F, optional).
Dew Point Accuracy	±0.2° (±0.36°F) nominal.
Depression Capability	90°C (162°F) with flow rate of 0.25L/m (0.5 SCFH) Air at one atmosphere.
Depression Slew Rate	2°C (4°F) per second at 25°C.
Dew Point Sensitivity	±0.06°C (±0.1°F).
Sample Flow Rate	0.25 to 2.5 liters/minute (0.5 to 5.0 SCFH).
Sample Pressure	0-21 Kg/cm² (0-300 psia) maximum.
Ambient Operating Temperature	
Control Unit	4°C to 50°C (40°F to 122°F).
Sensor	-50°C to +75°C (-58°F to+167°F).
Auxiliary Coolant	Water or other suitable liquid, 2 liters/minute (0.5 GPM) minimum at 10.5 Kg/cm² (150 psi) maximum and +15°C (+60°F) maximum. NOTE: Coolant is required only when measuring dew points below -50°C.
Options	Air temperature or pressure inputs Degree Fahrenheit display and outputs. %RH; PPMs; Grains/lb H_2O per lb dry air. BCD outputs, parallel, latched. Additional readout display for dew point or air temperature/ pressure. Alarm set; 4-20 mA; PPM_v analog.
Accessories	-Mirror microscope -Extension cable for remote mounting of sensor up to 500 feet -Sample System Kit -Panel Mounting Kit -Rack Mounting Kit -Ambient Temperature Kit -In-Line Ambient Temperature Sensor Mount -Pressure Transducer
Outputs, Optional	NOTE: As optional outputs are added, standard outputs are still simultaneously available.
Air Temperature	1 VDC per 10°C/polarity VDC out X10 = Air temperature in °C 0 to +10VDC for -75°C to +75°C
Degree Fahrenheit Analog Outputs	-1.0 VDC to +1.67 VDC (-100°F to +167°F).
BCD Output	3-1/2 digits plus polarity in 8-4-2-1 code with update strobe. Switch selectable to represent DP, AT, or output of COMP™ option.
COMP™ Module	Analog 0-10 VDC or 0-5V out corresponding to digital output computed for function programmed. Digital output with range information displayed on front panel. RS-232C output available.
Front Panel Indicators	Display Selectors Dew Point Air Temperature/Pressure %RH/PPM Optional Parameter CBC (Continuous Balance Control) Clean Sensor Mirror Lamp Test Sensor Diagnostics Maximum Cool Select AC Power on/off

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Display Range	X1 X10 X100
Control Condition	Heat (RED) Operate (AMBER) Cool (GREEN)
Outputs, Standard Dew Point	1 VDC per 10°C/polarity, VDC X10 = Dew Point in °C 0 to +10 VDC for -75°C to +100°C (This output is available as a direct output or as the output of the Track and Hold feature to mask output temperature excursions during mirror cleaning operations.) Control Signals CBC Diagnostic Limit (tells when to clean sensor mirror). Sensor Diagnostic Alarm (mirror overtemperature or TE cooleropen/base overtemperature or sensor disconnected). Balance Mode indicator
Sensor Materials	Anodized aluminum, glass, stainless steel, and inert NEBS™ mirror surface.
Dew Point Temperature Sensor	3-wire platinum Resistance Thermometer (PRT) 100 ohms nominal at 0°C.
Number of Thermoelectric Cooling Stages	Three.
Mirror Condition	Front Panel indicator for need to clean mirror surface.
Power	115V/230 VAC ±10% 50 to 60 Hz 150 watts maximum
Weight	37 lb (16.8 Kg) (less any options).
Displays Standard	3-1/2 digit, 0.8-inch high LEDs with additional character used to indicate units of number being displayed.
Optional	A second display for presenting dew point or air temperature/ pressure data only.

Installation Procedures

To gain internal access to the Model 300 Microprocessor Controlled Humidity Analyzer electronics, perform the following: 1) ensure that the power to the instrument is off, 2) loosen the two latches on the front panel by turning them counterclockwise for several turns, 3) grasp the two latches and pull outward, and 4) withdraw the chassis from the cover. The chassis will not separate from the cover because catch brackets welded on each side of the inside cover restrain the rear panel from passing.

If the sensor is mounted on the rear of the instrument case, it is not necessary to disconnect it for this operation since it will remain fixed to the cover.

2.1 MECHANICAL INSTALLATION

The Model 300 Microprocessor Controlled Humidity Analyzer mechanical dimensions are shown in Figure 2-1. The basic instrument is designed for bench-top mounting with rubber feet for support. The instrument should be used in an area where the ambient temperature is between +40 and +120°F (+4 and +50°C) and where free air circulation is provided for the air inlet holes on the right-hand side of the equipment.

The ambient temperature range of the Model 300-S3 Sensor when mounted on the rear panel of the Model 300 Control Unit is the same as the Control Unit, +40 to +120°F (+4 to +50°C). When the Model 300-S3 Sensor is mounted remote from the Model 300 Control Unit using the Model 300-RK Remote Mounting Kit, the ambient temperature range of the Model 300-S3 Sensor is -55 to +160°F (-40 to +70°C).

2.2 ELECTRICAL INSTALLATIONS

The Model 300 Microprocessor Controlled Humidity Analyzer is provided with a standard 3-wire power line cord for use with a grounded 115 VAC, 60 Hz power outlet. Satisfactory operation is obtained over the range of 115 VAC ±10% and 50-60 Hz. The instrument requires up to a maximum of 150 watts and is fused with a 5 amp Slo-Blo fuse located on the rear panel (Figure 2-2). The instrument is also designed to operate on 230 VAC +10%. If operation on 230 VAC is required, the Control Unit should be extended and the 115/230 switch should be operated to the 230 VAC position. At the same time, fuse F1, located on the rear panel, should be changed to a 2.5 amp Slo-Blo type.

Output data connector J20 is located at the rear panel of the Model 300 Control Unit. Only isolated low voltages appear on J20; therefore, these outputs are not dangerous to touch. Mating connector P20 is provided to aid in making external connections to the Model 300 outputs. No output data connections are required for operation since the data generated by the Model 300 may be observed on the front panel display. However, when the Model 300 outputs are to be used for external recording or monitoring functions, connections should be made to P20 as shown in Table 2-1.

2.3 SAMPLING CONFIGURATION

The Model 300 Sensor gas sampling connections, while not intricate, may result in measurement difficulty if leaks and contamination problems exist. The Model 300 reads the dew point of the sample present in the sensor. However, contamination in the sample gas can result in some degree of error. Sample lines are connected by means of the 1/8 NPT sample ports at the sensor. Only clean lines which are nonhygroscopic and free of leaks should be used. Stainless steel, copper, or polypropylene tubing of 1/8 inch or 1/4 inch in diameter should be used. The lines may be cleaned with freon or chlorothene if residual cutting oils, particulate matter, etc., are suspected to be present. The use of valves, regulators, or numerous fittings should be avoided, and when regulating valves, pumps or flow gauges are used, they should be located on the exhaust side of the system, not between the sample and the sensor, if possible. The optimum flow rate is between 0.5 SCFH and 5 SCFH. The sensor is insensitive to flow direction. In most applications, it is desirable to utilize a sampling system in which the pressure at the sensor is the same as the pressure at the desired point of measurement. Pressure changes in the sampling system are accompanied by dew point changes and must be taken into account during data interpretation (see page 5-1). Where sample lines or components might be below the anticipated sample dew point temperatures, condensation may occur in the

Installation Procedures

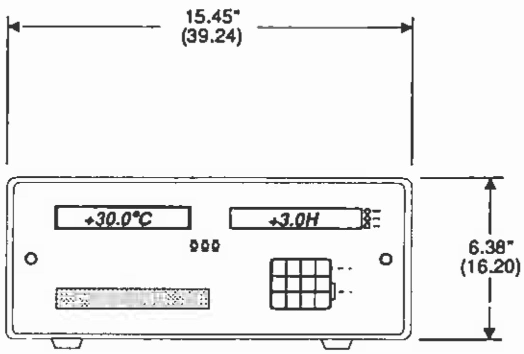
Table 2-1. P20 Output Connections.

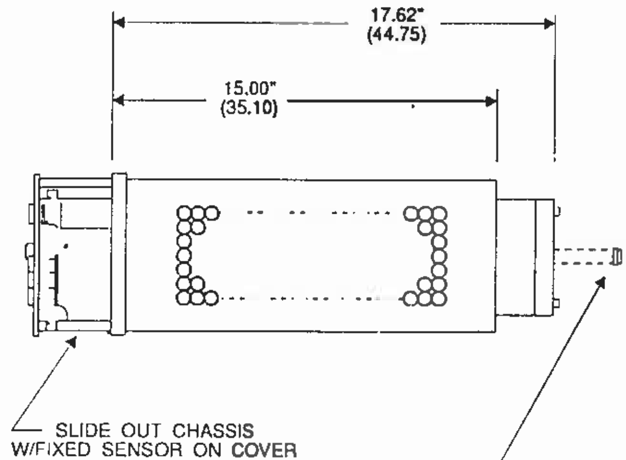
Model 300 Control Unit Rear Panel Connector J20	Function	Model 300 Control Unit Rear Panel Connector J20	Function
J20-A	Ground	-1	+24 VDC Unregulated
J20-B	Ground	-2	+15 VDC
J20-C	Ground	-3	+5 VDC Logic Supply
J20-D	Ground	-4	+5 VDC Reference
J20-E	Ground-Shield of AT PRT cable	-5	-15 VDC
J20-F	-4 VDC	-6	
J20-H	COMP™ Q1, MUX BCD	-7	COMP™ Q3, MUX BCD
J20-J	COMP™ DS1, MUX BCD	-8	COMP™ DS3, MUX BCD
J20-K	AT PRT (High)—Red Wire	-9	AT PRT (Common 1) White Wire
J20-L	Dew Point Track and Hold Output	-10	AT PRT (Common 2) Black Wire
	-7.5 to +7.5 VDC	-11	BCD Digit 4-2
J20-M	BCD Digit 4-4	-12	BCD EOC
J20-N	BCD Digit 4-1	-13	BCD Digit 4-8
J20-P	BCD Digit 3-2	-14	BCD Digit 3-4
J20-R	BCD Digit 3-1	-15	BCD Digit 3-8
J20-S	BCD Digit 2-4	-16	BCD Digit 2-2
J20-T	BCD Digit 2-1	-17	BCD Digit 2-8
J20-U	BCD 1/2 Digit, Low for "1," High for "0"	-18	BCD Polarity; "1" = Positive, "0" = Negative
J20-V	Alarm Relay—Normally Open	-19	Ground
J20-W	Alarm Relay—Arm	-20	4-20 ma Out
J20-X	Alarm Relay—Normally Closed	-21	4-20 ma Return
J20-Y	Spare	-22	Scaled PPM_V Output
J20-Z	Sensor Diagnostic Alarm Signal	-23	Balance/Track and Hold Indicator
J20-AA	AT Analog Output -7.5 to +7.5	-24	Clean Mirror Indicator
	VDC (EX. Analog in)	-25	DP Analog Output,
J20-AB	AT Analog Output, 0 to +10 VDC		-7.5 to +7.5 VDC
	(-75 to +75°C)		(-75 to +75°C)
J20-AC	DP Analog Output,	-26	DP Analog Output, °F
	0 to +10 VDC (-75 to +75°C) Direct		-1.0 to +1.7 VDC
J20-AD	AT Analog Output; °F, -1.0 to +1.7	-27	(-100 to +170°F)
	VDC (-100 to +170°F)		CBC Alarm
J20-AE	Test Output	-28	CBC Cooler Drive Monitor
J20-AF	COMP™ DS4, MUX BCD	-29	COMP™ DS2, MUX BCD
J20-AH	COMP™ Q0, MUX BCD	-30	COMP™ Q2, MUX BCD
J20-AJ	COMP™ Analog Output, 0 to +10 VDC		

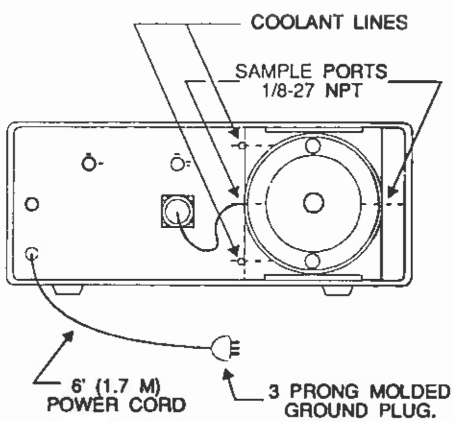
Abbreviations

AT = Ambient Temperature
BCD = Binary Coded Decimal
F = Fahrenheit
C = Celsius
MUX = Multiplexed
DS = Data Select
Q = Data Output
VDC = Volts Direct Current
EX = External
CBC = Continuous Balance Control
EOC = End of Conversions

CONTROL UNIT (BENCH MOUNT)







REAR VIEW

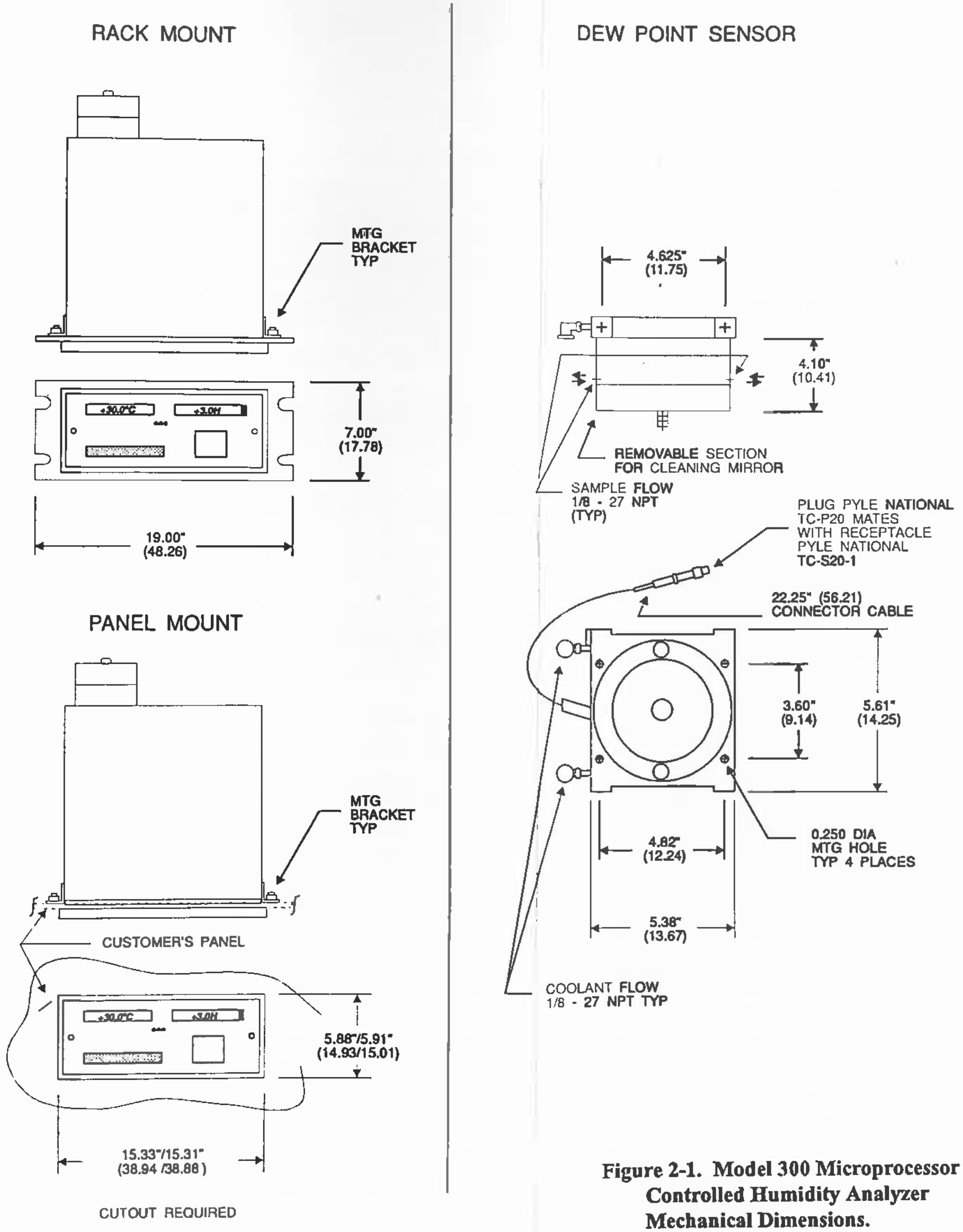


Figure 2-1. Model 300 Microprocessor Controlled Humidity Analyzer Mechanical Dimensions.

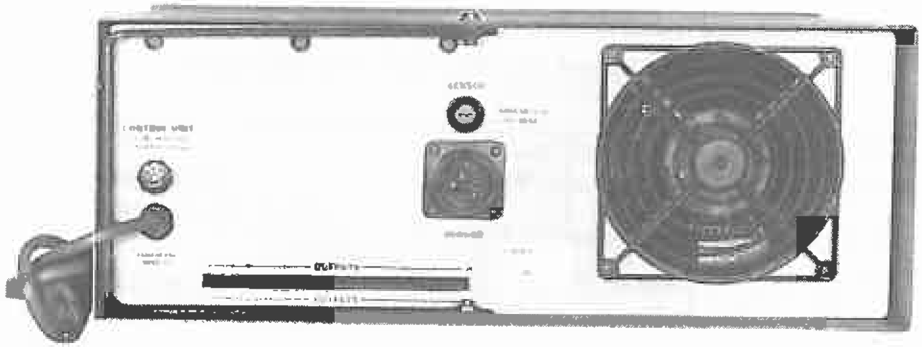


Figure 2-2. Model 300 Microprocessor Controlled Humidity Analyzer Rear Panel.

system, resulting in errors. In this event, heated lines and components must be used. Gases containing particulate matter should be filtered as close to the sampling point as feasible. Gases containing vapors (in addition to water) at concentrations that will cause them to condense at temperatures above the water dew point generally cannot be measured satisfactorily.

Section 7 of this manual contains additional information regarding sampling systems.

2.4 INSTALLATION OF OPTIONS AND ACCESSORIES

As a matter of convenience to the customer, installation of the Model 300 options will be made at the factory when ordered with the Basic Model 300 Microprocessor Controlled Humidity Analyzer. All Model 300 accessories are designed to be field installed. Instructions given below should be followed for the installation of accessories and options when ordered separately. (All plug-in circuit cards are keyed to prevent installation in the wrong mating connector.)

CAUTION

When withdrawing the Model 300 chassis from the cover, ensure that the chassis and cover are both properly supported because the chassis and power supply, when withdrawn from the cover, place the center of gravity beyond the rubber support mounts on the bottom of the cover. This is particularly true when the sensor is not mounted on the rear of the cover.

Once the chassis has been withdrawn, the plug-in circuit card retainer is accessible and can be removed by unscrewing the two captive screws that attach it to the power panel. It is necessary to remove this plug-in card retainer to gain access to all plug-in circuit cards, except the Model 300-RD optional second readout display. This option is plugged directly into J16 on the Main PWB directly behind the front panel in front of the red filter bezel provided.

Each plug-in card occupies a specific slot as designated in Table 2-2, which lists all plugs and jacks associated with the Model 300 and their function.

The only optional plug-in card requiring additional hardware is the Model 300-RD, which requires two No. 6-32 screws to attach the top of the option card to the front panel. Directions for installation of each option are detailed in the following paragraphs.

2.4.1 Model 300-RH COMP™ Computer Card

Installation Procedure

1. Turn AC power off and extend the Model 300 chassis as described in Section 2.4 above.
2. Remove the card retainer as described in subsection 2.4 above.
3. Referring to Table 2-2, insert the option card in the appropriate card slot with components facing forward.

Table 2-2. Model 300, Plug and Jack functions.

Card Name	Connector Designation	Connector Size	Key Located Between	Card Function
*Model 300-RH	J1	Dual 15	No Key	Computer Card
Model 300-CBC	J2	Dual 15	3/4	Continuous Balance Control Card
Model 300-MUX/ADC	J3A and B	2-Dual 15	No Keys	Multiplexer and Analog to Digital Converter
*Model 300-C/F	J4	Dual 6	1/2 and 4/5	Dual Celsius to Fahrenheit Converter Card
Model 300-PRT AMP	J5	Dual 6	2/3	Dew Point Platinum Resistance Thermometer Amplifier Card
*Model 300-PRT AMP	J6	Dual 6	2/3	Ambient Temperature Platinum Resistance Thermometer Amplifier Card
Model 300-T and H/A	J7	Dual 10	4/5	Track and Hold/Alarm Card
*Model 300-AS/MA	J8	Dual 10	1/2 and 7/8	Alarm Set Point, 4-20 mA, PPM_V Analog Output
*Model 300-BC	J9	Dual 15	4/5	Parallel, Latched BCD Output Card
Sensor Buffer	J10	Dual 15	12/13	Optics Amplifier
Switch Matrix	J11/12	15 + 15	—	Front Panel Instrument Control
	P/J13	6	Coded Plug	X1,X10,X100 Front Panel Indicators to Main PWB
	P/J14	40	Orientation	Main PWB to Fixed Front Panel LED Display
	P/J15			
*Model 300-RD	P/J16	Dual 15		Second Readout Display
	P/J17	9	Locking Bar	Main PWB to Rear Panel Sensor Connector
	P/J18	11	Orientation	Rear Panel Sensor Connector
	P/J19	20	Coded Plug	Main PWB to Power Panel
	P/J20	60	5/6	Rear Panel Output Connector
	P/J21	3	Orientation	AC Power Input to Main PWB
	J22	3	Ground Lug	Auxiliary AC Receptacle
	P/J23	6	Coded Plug	Heat, Operate, Cool Front Panel Indicators to Main PWB
	P/J24	3	Locking Bar	Main PWB to Power Panel
	P/J25	2	Orientation	Power Panel to Sensor Connector
	P/J26			
	P/J27	2	N/A	AC Power to Fan from Power Panel

*Plug-in options for the Model 300.

4. Install the card retainer removed in Step 2 above.

5. Slide the extended chassis back into the cover and secure the two front panel latches by turning clockwise until tight.

2.4.2 Model 300-C/F Dual Celsius to Fahrenheit Converter

Installation Procedure

1. Turn AC power off and extend the Model 300 chassis as described in subsection 2.4 above.

2. Remove the card retainer as described in subsection 2.4 above.

3. Referring to Table 2-2, insert the option card in the appropriate card slot with components facing forward.

4. Install the card retainer removed in Step 2 above.

5. Slide the extended chassis back into the cover and secure the two front panel latches by turning clockwise until tight.

2.4.3 Model 300-BC Parallel, Latched BCD Output Module

Installation Procedure

1. Turn AC power off and extend the Model 300 chassis as described in subsection 2.4 above.

2. Remove the card retainer as described in subsection 2.4 above.

3. Referring to Table 2-2, insert the option card in the approproate card slot with components facing forward.

4. Install the card retainer removed in Step 2 above,

5. Slide the extended chassis back into the cover and secure the two front panel latches by turning clockwise until tight.

2.4.4 Model 300-RD Second Readout Display

Installation Procedure

1. Turn AC power off and extend the Model 300 chassis as described in subsection 2.4 above.

2. Install the Model 300-RD into J16 with the components on the PWB facing forward.

3. Fasten the top of Model 300-RD to the front panel using the two No. 6-32 screws provided with the option.

4. Slide the extended chassis back into the cover and secure the two front panel latches by turning clockwise until tight.

2.4.5 Model 300 Pressure Transducer Option

The Pressure Interface Card supplied with this option is normally plugged into the Ambient Temperature card slot, J6. If a system must be configured to place the card in another location, this will be done at the factory, and a special Manual Addendum will be supplied.

When the card is to be plugged into J6, the wiring for the Pressure Transducer to the Model 300 rear connector is as follows:

Wire Color	Model 300 Pin No.	Signal
Red	1	Positive Excitation (about 25 VDC)
Black	A	Ground
Shield	D	Ground
Green	K	Positive Signal Output
White	9	Negative Signal Output

Pressure can be read when the AT/P switch on the Model 300 front panel is depressed. Generally, the decimal point must be ignored. For example, a reading of 25.0 is actually 250 psig.

2.4.6 Model 300-AT Ambient Temperature Accessory

This kit consists of a plug-in circuit card and the remote mounted air temperature sensor. Install the plug-in circuit card as follows:

1. Turn AC power off and extend the Model 300 chassis as described in subsection 2.4 above.
2. Remove the card retainer as described in subsection 2.4 above.
3. Referring to Table 2-2, insert the option card in the appropriate card slot with components facing forward.
4. Install the card retainer removed in Step 2 above.
5. Slide the extended chassis back into the cover and secure the two front panel latches by turning clockwise until tight.

To install the remote air temperature sensor, mount the sensor in the desired location for proper measurement of the ambient temperature, and proceed as follows:

1. Run the cable from the air temperature sensor to the rear panel of the Model 300 Control Unit, and attach the leads to the output connector provided in accordance with the following:

   Red to pin K of J20
   White to pin 9 of J20
   Black to pin 10 of J20
   Drain to pin E of J20

   Use standard soldering techniques to solder each wire to the appropriate pin, using sleeving or heat-shrink tubing over each joint.

2. Plug the connector and wires into the rear of the Model 300 Control Unit.

NOTES

1. Secure the connector to the rear panel of the instrument using the screws provided with the connector. These screws are important since they serve the dual purpose of securing the connector as well as supporting the main PWB where it extends through the rear panel.
2. The standard cable length supplied with the Model 300-AT Accessory is 10 feet. Cable lengths up to 500 feet may be purchased. For cable lengths greater than 50 feet, adjustment to the ambient temperature PRT Amplifier must be made. This is done at the factory when the longer cable length is ordered with the kit. If additional cable is added after purchase, this readjustment must be made by the customer. The procedure for this adjustment is similar to that given for the dew point PRT in Section 6 of this manual.
3. Refer to installation criteria contained in subsections 1.2.6 and 1.2.7.

2.4.7 Model 300 Panel/Rack

Model 300-PM Panel Mounting Procedure

1. Using the dimensions shown in Figure 2-1, prepare the appropriate panel cutout for the chassis cover of the Model 300.
2. To mount the angle brackets to the chassis cover, remove the chassis from the cover in the following manner:

   a. Disconnect the sensor connector, the output connector, or any connector that may be attached to the auxiliary AC output receptacle in the rear panel of the instrument.

   b. Disconnect the AC power cord from the source of AC power. Coil it and place it near the rear panel.

   c. Loosen the two latches on the front panel by turning several turns counterclockwise.

   d. Slowly withdraw the chassis from the cover by pulling on the front panel latches until the rear panel is restrained by the clips welded to the inside of the chassis cover.

Installation Procedures

NOTE

Exercise extreme care when withdrawing the chassis from the chassis cover as the center of gravity moves beyond the rubber mounting feet of the chassis cover and the chassis with its power panel weighs approximately 30 pounds.

e. With the rear panel pressed against the clips, slowly raise the front panel end of the chassis to allow the rear panel to pass beneath these clips and be removed from the chassis cover. Keep the two large capacitors of the power panel close to the top of the chassis cover at all times.

f. As the chassis is removed from the chassis cover, ensure that the power cord attached to the chassis is allowed to feed through the chassis cover. Place the chassis on a table for reinsertion.

3. Remove the four rubber mounts from the bottom of the chassis cover.

4. Remove the handle and handle brackets (if provided) located near the front of the chassis cover and utilize the mounting holes for the panel mount angle brackets.

5. Slide the chassis cover through the cutout in the panel created in Step 1. Insert the rear of the cover first.

NOTE

If the sensor is to be mounted to the rear of the chassis cover, remove it when installing the chassis cover into the panel opening to reduce the weight of the sensor/chassis cover combination.

6. Attach the two symmetrical angle brackets provided with this option to the two sides of the chassis cover from the rear of the panel on which the chassis cover is to be mounted. Use the flathead screws provided to secure the angle brackets to the chassis cover.

7. Install the jack screws provided into the angle brackets mounted in Step 6, and tighten evenly until the cover is tighly secured to the panel opening.

8. Reinstall the instrument chassis removed in Step 2 by reversing the removal procedure.

9. Reinstall the sensor to the rear of the chassis cover, if operation in this position is desired.

Model 300-RM Rack Mounting Procedure

1. Rack mounting is similar to panel mounting except that this option provides a standard 19-inch rack panel with the appropriate panel cutout already in place. Assemble the chassis cover of the instrument to the 19-inch rack panel following the procedure for panel mounting.

2. Install the rack panel as desired in a standard 19-inch rack. Vertical height required by the rack panel is 7 inches.

2.4.8 Model 300-RC Remote Mounting Kit Accessory

This accessory is used when locating the Model 300 Sensor remote from the Model 300 Control Unit. The maximum distance is 500 feet. The standard length of the cable included in the kit is 10 feet. If additional lengths of cable are required, it should be specified at the time of purchase.

NOTE

When the Model 300-RC Remote Mounting Kit is purchased with the Model 300 Microprocessor Controlled Humidity Analyzer, the Model 300 Control Unit Platinum Resistance Thermometer (PRT) amplifier will be adjusted for the length of cable purchased. When cable lengths greater than 50 feet are utilized, readjustment is necessary to maintain accuracy specification. Consequently, if the Model 300-RC Accessory is purchased after shipment of the Model 300 Microprocessor Controlled Humidity Analyzer and the cable length exceeds 50 feet, perform the PRT Amplifier Calibration Procedure included in Section 6 of this manual.

Installation Procedure

1. Turn AC power off.
2. Remove the Model 300 Sensor from the chassis cover of the Model 300 Control Unit by removing the four retaining screws and carefully unplug the sensor connector from the rear panel.
3. Attach the male end of the Model 300-RC Accessory Cable to the Model 300 Control Unit sensor connector.
4. Mount the sensor in the remote mounting location and attach the female end of the remote cable to the sensor cable.
5. Recalibrate the PRT Amplifier, if necessary, as discussed above.

2.4.9 Model 300-SS Sample System Kit Accessory

The Sample System Kit consists of a Neptune Dynapump Model No. 2, a Brooks 0-5 SCFH flowmeter, 8 feet of tubing, and all necessary hardware and fittings for attaching to a Model 300 Sensor. Interconnecting suggestions are included with this accessory.

2.4.10 Model 300-M Mirror Microscope Accessory Installation Procedure

Most Model 300 Sensors are equipped to accept this accessory. This can be determined by locating a removable plug in the center of the outside portion of the Sensor optical section. Remove the plug by using a large blade screwdriver and carefully screw the microscope into the optical section in place of the plug. Note that the attaching threads are very fine and are subject to cross-threading and subsequent damage. The eyepiece of the microscope is adjustable to suit different users and should be adjusted for sharp focus accordingly. Note that very little light is available until dew or frost forms on the mirror surface.

Operation

3.1 PREPARATION FOR OPERATION

The Model 300 Microprocessor Controlled Humidity Analyzer, as shipped, is set up for operation 115 VAC and has been tested as such. However, prior to using the equipment, certain precautionary checks should be made to ensure that the Model 300 is set up properly for the particular application in question.

3.1.1 AC Input Voltage Selection

Select the input voltage planned for your installation, either 115 VAC or 230 VAC. Switch S1 makes this selection easy after the chassis of the Model 300 has been slightly withdrawn from the chassis cover. When shipped, the Model 300 is equipped with a 3 AG, 5 amp Slo Blo fuse. If operation is planned for 230 VAC, fuse F1 should be changed to a 3 AG, 2.5 amp Slo Blo.

CAUTION

When changing the fuse for any reason, ensure that the Model 300 power cord has been disconnected from the source of AC power. The fuse could be electrically energized otherwise.

Fuse F1 is located on the rear panel of the instrument. Access to switch S1 for 115/230 VAC operation is gained by loosening the two front panel latches and withdrawing the chassis from the chassis cover about 4 inches. S1 is located on the edge of the Main PWB behind the front panel on the right-hand side.

3.1.2 Initial Setup

Locate the Model 300 Microprocessor Controlled Humidity Analyzer in a clean area where free convection of air is possible underneath and around the sides of the Model 300 Control Unit chassis. Install any options not previously installed and any accessories, following the installation instructions of Section 2 of this manual. Operate any option switches to their appropriate positions for the application (see below). Make any connection to external recording or monitoring equipment as necessary at rear output connector J20. Connect the Model 300 Sensor to the gas sample with cleaned, nonhygroscopic piping with leak-free connections, keeping the sample lines as short as possible, and provide for a sample flow rate of about 2 SCFH. Use nonhygroscopic filters, if necessary, to remove particulate matter from the gas sample.

3.1.3 Switch Selection Setup

Prior to operation of the equipment or as required subsequently, certain switch selections can be made to set up the instrument for the operation desired. A section of the switch is properly set when the appropriate end of the rocker is depressed. The black dots in Figure 3-1 indicate normal opration. Certain options are required in some cases for these setups to be meaningful. Switches to be set are as follows:

S2 and S4 (located on the Main PWB). See Figure 3-1.

S2-1 Selects either Dew Point/Ambient Temperature or Relative Humidity to be processed by the 300-BC BCD option. See subsection 3.1.3.3.

S2-2 Selects either °C or °F display. See subsection 3.1.3.2.

S4-1 Selects either the sensor buffer output or the Alarm Set potentiometer (option) to be front panel displayed. See subsections 3.3 and 3.4.5.

S4-2 Selects whether Dew Point Temperature is displayed as direct data or as "hold" data during mirror cleaning. See subsection 3.1.3.1.

AT/DP switch (located on MUX/ADC card) selects whether ambient temperature (option) or dew point temperature is displayed on the left display (300-RD option). See subsection 3.1.3.4.

S1 and S2 (located on the CBC Card). S1 (8 positions) and S2 (9 positions) are not normally used. They should all normally be in the closed position. S2 position 9 **must** be closed for normal system operation. The switches are closed when the small toggle arm is pushed back towards the board. See subsection 3.7.

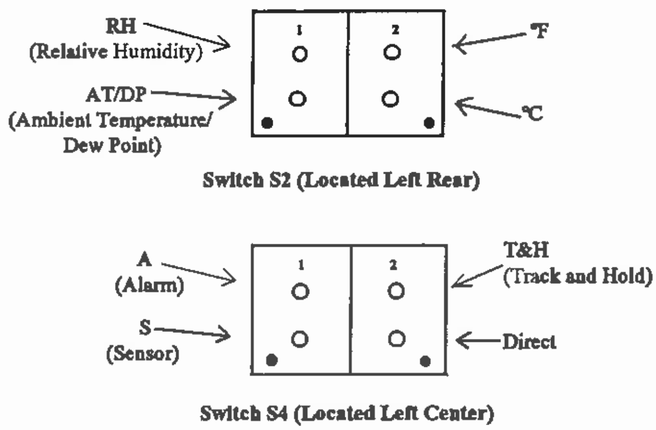


Figure 3-1. Configuration of Switches S2 and S4.

3.1.3.1 Track and Hold Signal Selection

This instrument is equipped with a Track and Hold Amplifier feature that allows the user to have and use an analog output for dew point data; although the direct dew point data is being tracked normally, the Track and Hold feature holds the analog dew point value during the period of sensor mirror cleaning. This feature is especially useful when using the Model 300 Microprocessor Controlled Humidity Analyzer in process control applications. The process controllers can be masked from the temperature excursions experienced by the sensor mirror during cleaning. After cleaning, the Hold circuitry continues to hold the analog value until control on the dew point by the instrument is again achieved. Both direct and Track and Hold Analog Outputs are available simultaneously. However, the operator has a choice of whether the direct or the Track and Hold output will be used for front panel displays and for options such as the Model 300-RH COMP™ that operate on the data. Switch S4, Section 2, controls this function. (See Figure 3-1.) To display direct dew point data, depress the forward side of switch S4-2 down. To display Track and Hold dew point information, depress the rear side of switch S4-2 down. Switch S4 is located on the left side of the Main PWB directly in front of the Track and Hold board, which is plugged into J7.

3.1.3.2 °C or °F Display Selection

The Model 300 generates data for dew point and ambient temperature (if so equipped) in degree Celsius engineering units. If degree Fahrenheit outputs are required, the Model 300-CF option is incorporated. This option provides simultaneous analog outputs for dew point and ambient temperature. In addition, either degrees Celsius or degrees Fahrenheit may be displayed on the front panel displays. Selection is made by use of switch S2 located on the left side of the Main PWB at the rear, near the fan. When the forward side of switch S2-2 is depressed, °C will be displayed. Similarly, when the rear side of switch S2-2 is depressed, °F data will be displayed.

NOTE

The optional RH COMP™ is programmed to process either °C data or °F data. If the °C/°F option is installed, °F must be selected for the RH, PPM_v, or Grain outputs for the RH COMP™ to be valid. The data that are displayed, either °C or °F, are the data that are used for additional processing by other options such as the Model 300-RH COMP™ and the Model 300-BC BCD output module.

3.1.3.3 BCD Data Source Selection

When the Model 300 Microprocessor Controlled Humidity Analyzer is equipped with a Model 300-BC BCD output module to provide parallel, latched, T^2L compatible outputs representing 3-1/2 digits of displayed data, it is necessary to select the source of data for the Model 300-BC option. This selection is made by switch S2 located on the left side of the Main PWB at the rear, near the fan. When the forward section of switch S2-1 is depressed, data related to dew point or ambient temperature are selected for presentation to the Model 300-BC option module. The selection of either dew point or ambient temperature for presentation at the output connector in BCD form is determined by the selector switch on the Model 300-BC option PWB. However, when the rear of switch S2-1 is depressed, then the output of the Model 300-RH COMP™ is selected for presentation to the input of the Model 300-BC option. In this configuration, the data generated by the Model 300-RH COMP™ computer for front panel display can also be presented in BCD form at the output. BCD data for only one set of data can be selected for BCD output at any given time.

3.1.3.4 Second Readout Display Data Source Selection

If the Model 300 Microprocessor Controlled Humidity Analyzer is equipped with a Model 300-RD second readout display, a choice of the data presented by this second display can be selected to be either dew point or ambient temperature only. Selection of dew point temperature information or ambient temperature information for the second display (left-hand display on the front panel) is determined by the position of the switch located on the top right-hand end of the MUX and ADC PWB plugged into J3A and J3B on the Main PWB. To gain access to the switch, slide out the chassis and remove the PWB retainer. Operating this switch to the left (AT) selects ambient temperature data for display. Operating this switch to the right (DP) selects dew point data for display. It is necessary that the instrument be equipped with the Model 300-AT Ambient Temperature Accessory for ambient temperature to be displayed.

3.1.3.5 Front Panel Control Switches

Twelve switches are provided on the front panel of the instrument in a switch matrix as a means of controlling and monitoring the operation of the instrument. Eight of these switches relate to the status of instrument operation and four relate to selection of data to be displayed in the primary (right-hand) instrument display. The function of each switch is described below. Refer to Figure 3-2 for switch locations.

DP	AT/P	RH/PP		- Function
CLN MIR	CBC			- Status
LAMP TEST	SENS DIAG	MAX COOL	ON/ OFF	

Figure 3-2. Switch Locations.

Status Switches

1. AC PWR (or ON/OFF)—This push-on/push-off type switch controls the application of AC power (115/230 VAC) to the instrument. When power is on, the switch illuminates and the primary display (and secondary display if the instrument is so equipped) is energized.
2. MAX COOL—This switch is provided to enable the operator to override the other functions of the instrument and cause the instrument to apply the proper cooling current to the dew point sensor, causing it to cool the mirror surface to its lowest point attainable. This test function is useful to check the cooling capacity of the sensor to ensure that it is capable of reaching the anticipated dew point of the application. This push-on/push-off switch illuminates when on.

NOTE

Activating MAX COOL under normal ambient dew point conditions results in excessive moisture condensation in the sampling chamber of the sensor. Cleaning of the mirror according to the procedures of subsection 6.2.2 is recommended prior to returning to normal operation.

3. SENS DIAG—This switch functions as a Sensor Diagnostic indicator to provide the operator with diagnostic information relating to sensor performance. When this light is blinking, it indicates that a problem exists with the sensor in one of two areas.

The first area concerns the maximum temperature of the mirror surface in the sensor. For 3-stage thermoelectric cooler sensors, this temperature cutoff is set at approximately +75°C. If the mirror temperature exceeds this temperature for any reason, the SENS DIAG indicator will flash and the power supply to the sensor will be shut down. Flashing will stop as soon as the temperature of the mirror drops below +75°C. No manual resetting of this condition is required. If the SENS DIAG indicator is flashing, check the sensor mirror overtemperature by observing that the dew point temperature data on the front panel display is in the area of +75°C.

The second area of dew point sensor monitoring is related to the current that flows in the thermoelectric cooler. If this current drops to zero or reverses for an inordinate amount of time, then the SENS DIAG indicator will flash and the power supply servicing the thermoelectric cooler will be shut down. Under these conditions, it is necessary to locate and correct the cause of the problem and then to manually press the momentary SENS DIAG switch to enable the sensor power to again energize the sensor. When the SENS DIAG indicator is flashing and the sensor mirror temperature is not at +75°C, then the indicator is flashing to indicate that a problem exists in one of the following areas:

a. The sensor is disconnected.

b. The fuse in series with the sensor thermoelectric cooler, located on the instrument rear panel, is either missing or blown.

c. The sensor internal thermostat in thermal contact with the base of the sensor has opened because the base temperature has exceeded +100°C. Generally, this will occur when the sensor is not mounted on the rear of the instrument and does not have the benefit of being cooled by the instrument fan or the sensor coolant flow has been interrupted. One of the major purposes of this diagnostic function is to indicate loss of sensor base coolant when measuring very low dew points. An external alarm signal is provided at the rear instrument panel connector J20 on pin Z. This alarm signal is a +5 volt C/MOS 1 Hz clock signal during alarm condition.

4. LAMP TEST—This momentary switch causes all front panel lamps to be energized to enable the operator to ascertain that all indicators are functioning and that no bulbs in the switch matrix or segments in the displays or other front panel indicators are inoperative.

5. CBC—This Continuous Balance Control switch serves two functions. The indicator in this switch flashes whenever the instrument is holding the dew point analog data, i.e., the Track and Hold feature is in the Hold mode. This occurs during the mirror cleaning exercise and for a period of time thereafter.

   The other function of the push-on/push-off CBC switch is to cause the instrument to enter the balance mode during sensor cleaning operations. Whenever the CLN MIR indicator is illuminated, sensor cleaning maintenance should be scheduled. When CBC is on, the sensor mirror will be heated to remove any condensates and will remain heated as long as the switch is on. This switch will also flash when on, since the Track and Hold feature will be in the Hold mode.

6. CLN MIR—This CLeaN MIRror indicator serves as an indicator only. There is no switch function associated with this location. Under control of the microprocessor monitoring the operation of the sensor, when the reference channel indicates that sensor mirror cleaning is going to be needed, this indicator illuminates to alert the operator that sensor cleaning maintenance should be scheduled as soon as possible before errors in dew point measurement are introduced and the instrument cannot further compensate for particulate matter buildup on the sensor mirror surface. Note that the CLN MIR indicator will always be ON after turn-on and whenever the CBC switch is pushed in.

Function Switches

DP, AT/P, RH/PPM, ☐—These four switches are momentary switches that provide a means for selecting the data to be displayed in the primary display directly over the Switch Matrix on the front panel. When power is turned on to the instrument, the DP (Dew Point) indicator illuminates and the data displayed in the primary display will be the dew point temperature data.

If the Model 300 Microprocessor Controlled Humidity Analyzer is equipped with a Model 300-AT Ambient

Temperature Accessory, then depressing the AT/P switch causes this switch to be illuminated instead of the DP switch, and the data displayed will now correspond to ambient temperature.

The P portion of this switch is so labeled for those special applications that require pressure as an input to the Model 300-RH COMP™ option. Under these circumstances, the user provides a means of measuring the pressure of his system and inputting this data to the Model 300 Control Unit via the rear panel connector. Consult the factory for details of this special feature.

In a similar manner, depressing the momentary function RH/PPM switch will cause this switch to be illuminated, and the output of the Model 300-RH COMP™ will be presented for display in the primary display. All other function indicators will be extinguished. The Model 300-RH COMP™ must be provided for this feature to operate. The Model 300-RH COMP™ can be provided with a fixed program to provide an output related to dew point only or dew point and one other input parameter, i.e., ambient temperature or pressure. Using almost any conceivable algorithm will provide an output for display in engineering units. Only one output can be provided at a time.

When the RH/PPM switch is selected, then in addition to displaying the output of the Model 300-RH COMP™, the display character at the end of the numerical data displayed will change from a °C or °F to an H, indicating that the data being displayed is a calculated value based on the humidity measurements. The □ switch also causes the output of the Model 300-RH COMP™ to be displayed as before, but the trailing symbol in the display changes to a □ symbol to indicate that the data represents Grains or some other special calculated output. Consult the factory for special programming requirements to provide outputs directly in the engineering units most useful for a particular application.

3.1.3.6 Multiplier Indicators X1, X10, X100

When power is first turned on to the Model 300, the X1 indicator will be illuminated. Whenever dew point or ambient temperature are selected for display, the data displayed is always read directly, regardless of the display multiplier illuminated. However, whenever the output of the Model 300-RH COMP™ is selected for display by either the RH/PPM or □ function selectors, then the data in the primary right-hand display must always be multiplied by the multiplier, X1, X10, X100 that is illuminated. This multiplier feature allows the Model 300 to display larger numbers than would otherwise be possible with the 3-1/2 digit display.

3.1.3.7 Control Condition Indicators

Three indicators are provided on the front panel to give the operator an immediate indication of the operation of the instrument. Each one, HEAT, OPeRate, and COOL, when illuminated, indicates the status of the microprocessor control loop that is constantly maintaining the sensor mirror with the proper layer of dew or frost in normal operation. The significance of these indicators, when illuminated, is as follows:

<u>HEAT</u>

a. Illuminates whenever the CBC switch is on and the instrument is in the balance or sensor cleaning mode.

b. Illuminates in the operate mode whenever the control loop senses too much moisture on the sensor mirror and the sensor mirror is being heated rapidly to regain control. This condition would occur, for instance, whenever a rapid step increase in moisture level is experienced by the sensor.

<u>COOL</u>

a. Illuminates whenever the MAX COOL switch is on, forcing maximum cooling current to be supplied to the sensor.

b. Illuminates in the operate mode whenever the sensor mirror is dry, such as immediately following a balance or sensor cleaning operation or when a rapid step decrease in moisture level is experienced by the sensor.

<u>OPeRate</u>

When in the operate mode and the sensor mirror surface has dew or frost present in the proper amount, this indicator will be illuminated to indicate that the instrument is in control of the dew/frost layer and that the output data is valid.

3.2 OPERATING PROCEDURES

Prior to operating the instrument, ensure that all options are installed, that all switches within the instrument are set to their desired positions, and that all necessary connections to output connector J20 at the rear panel have been made.

1. After installing the instrument and the dew point sensor in the operating environment, turn the instrument ON by means of the AC PWR switch. The instrument will immediately go into a self-standardization mode to initialize itself and, unless the CBC switch is on, the instrument will, after a period of time, automatically switch to the operate mode.

2. Momentarily depress the LAMP TEST switch to ensure that all indicators and all segments of the displays are operating.

3. Observe the operation of the instrument. It should come out of the initial standardization mode and the COOL light should come on, indicating that the instrument has entered the operate mode and that the sensor mirror is being cooled to the dew point temperature.

4. Observe that when the dew point temperature is attained, the OPR indicator is illuminated instead of the COOL indicator. In some instances, especially at higher dew points, and high flow rates, the instrument may overshoot initially and the HEAT indicator may come on momentarily to indicate that the sensor is being heated to rapidly regain control.

5. Operate the Function switches in the top row of the front panel Switch Matrix and observe that the data being displayed is proper.

   NOTE

   Directly following power turn-on, the output of the Track and Hold circuit will be in the Track mode because initially the Hold circuitry has nothing to remember or hold. Therefore, the Track and Hold output will track the direct output during the standardization and the beginning of the operate cycle.

6. Occasionally, visually monitor the CLN MIR indicator in the Switch Matrix. This indicator indicates when sensor mirror cleaning is going to be required. The length of time that transpires between one sensor cleaning and the next will depend primarily on the cleanliness of the sample gas being measured and the flow rate of the sample gas that is bringing contaminants to the mirror surface. A sensor mirror cleaning maintenance schedule should be set up based on experience gained or, if desired, this can be done only upon receipt of a signal from the CLN MIR indicator. To preclude the possibility of introducing significant errors into the dew point readings, sensor cleaning should occur as soon as possible after the indication that cleaning is going to be required is made available.

7. When it is desired or required to clean the sensor, operate the CBC Switch. The CBC indicator will flash—indicating that the Track and Hold circuitry has entered the Hold mode. Clean the sensor as soon as possible after operating the CBC Switch to ON to minimize the amount of time the Hold circuitry must remember the previous dew point reading.

8. After the mirror has been cleaned, switch CBC to OFF. The CBC indicator will continue to flash, indicating that the Track and Hold circuitry is still in the Hold mode. The CBC microprocessor will now restandardize the instrument and cause it to re-enter the operate mode. The CBC indicator will continue to flash until the instrument is again controlling on the dew point.

3.3 SENSOR BUFFER CARD

The proper adjustment of the circuits specified in this section is critical to the proper operation of the Model 300 system. The Sensor Buffer, located in position J10 on the Main PWB, contains the interfacing circuitry required to standardize the sensor to the system electronics.

Operation

These adjustments must be made/checked for any of the following reasons:

1. A complete new sensor has been installed.
2. Either the top or the bottom of the sensor is replaced.
3. The sensor is changed from either a local to remote position, or vice versa, or the remote cable length is changed.
4. After the sensor mirror has been cleaned.
5. Either the Sensor Buffer Card or the CBC Card is replaced.
6. The system performance seems to be incorrect.

The operator should go through the procedure several times to become familiar with it. Although it may seem long on paper, it is quite fast to accomplish once you are familiar with the procedure.

The front panel display is used to monitor particular memory locations in the microprocessor on the CBC Card. These locations are selected by switches S1 and S2 on the CBC Card. Depressing the unmarked switch in the Switch Matrix just to the right of the CBC Switch allows the contents of these locations to be displayed. When this unmarked switch is depressed, the descriptive character at the right-hand end of each data display will indicate the letter "A" as an Alarm or Abnormal condition, and the FUNCTION light in the top row of the Switch Matrix will be extinguished.

NOTE

The RC Potentiometer located on the Sensor Buffer Card is the Rate Compensation Potentiometer. It should normally be set as follows: turn the RC Potentiometer fully CCW, and then turn it 5 turns CW. If the system tends to oscillate around the dew point temperature, it may be necessary to turn this potentiometer a few turns one way or the other.

3.3.1 Procedure

1. If necessary, clean the sensor mirror with Type A cleaner. Refer to subsection 6.2 in the Manual for when and how to clean the mirror.

NOTE

If the mirror is cleaned while the power to the instrument is ON, shut the power OFF after replacing the optical section of the sensor. This will allow the microprocessor circuits to be reset.

2. Turn power to the instrument ON, and depress the CBC Switch to place the instrument in the Balance mode.
3. Extend the Model 300 chassis to gain access to the Sensor Buffer Card, located in position J10 near the fan at the rear of the chassis.
4. Depress the unmarked switch just to the right of the CBC Switch and note that the display(s) indicate the letter "A" on the right-hand end and that the FUNCTION lights in the top row of the Switch Matrix are extinguished.
5. On the CBC Card, position J2, set S2 sections 1 through 4 to the OPEN position. Sections 5 through 9 should be closed.

NOTE

The "OPEN" position for the sections of S1 and S2 is obtained by pulling the small toggles forward toward the front panel. Note the word OPEN marked on the switch.

The following shows the relative position of the components on the CBC Card that require attention:

S2===S1===========================R16=R8

DRY WET

NOTE

The following steps adjust the DRY (reference) mirror circuits.

6. On the CBC Card, set S1 sections 4 and 6 to the OPEN position. The other six sections should be closed.

7. Observe the reading in the display(s) and adjust the DG (Dry Gain) Potentiometer on the Sensor Buffer Card to obtain a reading between 50.0 and 55.0.

   If it is not possible to achieve this value with the DG Potentiometer, then set the potentiometer to about mid position. (To set a multiturn potentiometer to mid position, rotate the potentiometer shaft at least 20 turns CCW. Then rotate the potentiometer about 10 turns in a CW direction.)

   Next, adjust the DRY LED Current Potentiometer, R16, on the CBC Card to obtain the required reading of 50.0. Potentiometer R16 is the second potentiometer from the extreme right side of the CBC Card. The LED Current Potentiometer can be used as a coarse adjustment, and the DG Potentiometer on the Sensor Buffer Card can then be used to fine tune the adjustment. Unless the sensor is replaced, future adjustments should be able to be made with the DG Potentiometer only.

NOTE

The following steps adjust the WET (dew collecting) mirror circuits.

8. On the CBC Card, set S1 sections 2, 4, and 6 to the OPEN position.

9. Observe the reading in the display(s) and adjust the WG (Wet Gain) Potentiometer on the Sensor Buffer Card to obtain a reading between 50.0 and 55.0.

   If it is not possible to achieve this value with the WG Potentiometer, then set the potentiometer to about mid position.

   Next, adjust the WET LED Current Potentiometer, R8, on the CBC Card to obtain the required reading of 50.0. Potentiometer R8 is the potentiometer at the extreme right side of the CBC Card. The LED Current Potentiometer can be used as a coarse adjustment, and the WG Potentiometer on the Sensor Buffer Card can then be used to fine tune the adjustment. Unless the sensor is replaced, future adjustments should be able to be made with the WG Potentiometer only.

10. After the above adjustments have been made, release the unmarked switch operated in Step 4, wait for approximately 3 minutes, and then release the CBC Switch to return to normal operation.

    The switches on the CBC board can be left in either of the conditions indicated above without affecting operation of the system.

3.4 OPERATION OF OPTIONS AND AMBIENT TEMPERATURE ACCESSORY

When the basic Model 300 Microprocessor Controlled Humidity Analyzer is equipped with various options and accessories, the basic operation just described is unaffected. Added options and accessories increase the versatility of the basic instrument. The added features of each are discussed below.

3.4.1 Model 300-RD Second Readout Display Option

The basic Model 300 is equipped with one display. The dew point temperature is shown on this display in degrees Celsius, as indicated by the letter C to the right of the decimal digits. When only one display is incorporated and the Model 300-AT Ambient Temperature Accessory is used, the data selected for display are controlled by mutually exclusive selector switches DP or AT/P. If the Model 300-RH COMP™ RH Computer option is also incorporated, then the RH/PPM or ☐ selector switch can be used to display the output of this COMP™ option.

The character H (for RH) or P (for PPM_v) is displayed to the right of the decimal digits when RH/PPM is selected for display. However, if this Model 300-RD option is utilized, providing two simultaneous displays, then the left-hand display will always display dew point data or ambient temperature data only and the right-hand meter will display the data selected by the function switches, either DEW POINT, AT/P, RH/PPM, or □. Dew point or ambient temperature data can be selected for the left-hand display with the AT/DP toggle switch on the MUX and ADC card.

3.4.2 Model 300-CF °F Readout Capability Option

When the basic Model 300 Microprocessor Controlled Humidity Analyzer is equipped with this option, °Fahrenheit analog outputs are provided simultaneously with the °Celsius analog outputs. Front panel display of data may, however, be either in °F or °C. By sliding the chassis out in the Model 300 Control Unit, switch S2 on the Main PWB becomes accessible. This switch determines which analog voltage, °C or °F, will be digitized for display purposes, for use by the Model 300-BC BCD output module, and for the input to the Model 300-RH COMP™. See Figure 3-1 and NOTE of subsection 3.1.3.2.

This option provides for °F conversion of **both** dew point and ambient temperature even though dew point may be the only parameter the instrument is equipped to measure. Later addition of an ambient temperature capability by means of the Model 300-AT Ambient Temperature Accessory does **not** require an additional Model 300-CF option. (If so equipped, both dew point and ambient temperature must be displayed in the same format, either °F or °C.)

3.4.3 Model 300-BC BCD Output Module

This module provides 3-1/2 digit, parallel, latched T²L compatible outputs for either dew point **or** ambient temperature. Selection of dew point (DP) or ambient temperature (AT) for BCD output is made by means of a slide switch, S1, located on the top of the Model 300-BC Option Circuit Card. Access to this circuit card is made by withdrawing the chassis from the Model 300 Control Unit chassis cover.

Connections to the BCD outputs are made at the Model 300 Control Unit rear panel connector J20 in accordance with the output pin data shown in Table 2-1. Data are valid whenever the EOC line (J20-12) is high (+5 volts). Digit 4 is the Least Significant Digit (LSD). The 1/2 digit (J20-U), the Most Significant Digit (MSD) information, is reversed from the other outputs in that a low (0 volts) output represents a digit 1 for the MSD, whereas a high output (+5 volts) on this MSD line indicates that the MSD is a zero. The polarity output on J20-18 is a low (0 volts) for NEGATIVE and a high (+5 volts) for POSITIVE.

3.4.4 Programmable Read Only Memory (PROM)

Whenever a Model 300-RH COMP™ is used, the proper Programmable Read Only Memory (PROM) must be inserted in chip location A12 on the COMP™ PWB. Each PROM, either standard or special, contains the proper program to enable the COMP™ to calculate the desired output based on the inputted data. Therefore, it is imperative that the input data be in the proper units in order for the output data to be calculated properly. Since almost all calculations involve dew point data, care must be taken to ensure that the dew point data is presented to the COMP™ in the proper units, °C or °F. The PROM can be programmed to accept either input, but not both at the same time. If an instrument is purchased without a Model 300-CF Degrees C to Degrees F option, and a Model 300-RH COMP™ is also purchased, then any PROM provided will be programmed to accept °C input data. If the Model 300-CF converter is ordered, then the PROM delivered will be designed to operate on °F inputs. If it becomes necessary to change instrument operation from °C to °F and back again for user convenience, then the PROM installed in A12 on the COMP™ PWB would have to be changed accordingly.

3.4.5 Special Alarm, 4-20 mA, PPM_v Option

This card has several option capabilities that can be factory tailored to a customer's specific needs. The three basic options are alarm set, 4-20 milliampere output, and PPM_v analog output. The card plugs into motherboard socket J8.

Operation

3.4.5.1 Alarm Set

This option provides a single alarm set point that can be set as a percentage of full scale output. Switch S1, located on the option board, selects the 0-10V signal output to be monitored.

Switch Position	Signal
1	Dew Point
2	Air Temperature (optional)
3	Relative Humidity (optional) (GR) or PPM_v (optional)

A SPDT relay provides isolated contacts for remote indication of set point crossover. The relay contacts are as follows:

	Option 1	Option 2
VA (Resistive Load)	8 VA	50 VA
Maximum volts	100 VDC	
Maximum Switching Current	0.25A	
Maximum Operating Current	0.5A	

The alarm relay is accessed through the rear panel connector P20 as follows:

Relay Arm	Pin W
N.O. Contact	Pin V
N.C. Contact	Pin X

The Alarm Set Point potentiometer is located on the option board and is the left-hand potentiometer, marked Rx. Use caution **not** to adjust potentiometer R5 next to it. R5 has been factory adjusted as a voltage reference.

The output of the Alarm Set Point potentiometer, Rx, can be observed on the front panel display as follows:

1. The system must be in operation.
2. Select either DP or AT/P, even if RH or PPM_v is to be monitored.
3. Set Main PWB switch S4-1 to "A." (See subsection 3.1.3.)
4. Depress the right-hand Blank Switch (located just above the Power Switch). The display should now indicate a number between 00.0 and 99.9.
5. Adjust the display reading to % full scale alarm point desired by adjusting potentiometer Rx. For dew point temperature and air temperature, the relationship is:

$$\% \text{ full scale setting} = \frac{\text{Desired relay trip point in °C} + 75}{1.5}$$

or

$$\% \text{ full scale setting} = \frac{\text{Desired relay trip point in °F} + 103}{2.7}$$

For Relative Humidity, the relationship is:

% Full scale setting = % of Relative Humidity

For PPM_v, an addendum to the manual will be provided.

6. Release the right-hand Blank Switch.

3.4.5.2 4-20 mA

This option provides a current output signal which is proportional to the voltage supplied to it. Switch S2 on the option board selects the 0-10 volt signal to be monitored in the same manner as the Alarm Set option. The 4-20 mA current output is available at rear connector P20, pin 20(+) and pin 21 (return). The current can be either nonisolated (Option 3) or isolated (Option 4). The load resistance range for each option is as follows:

Option 3	0-500 ohms maximum
Option 4	0-1000 ohms maximum

The 4-20 mA output corresponds to the instrument range of -75° to +75°C (-103°F to +167°F). The transfer functions for dew point and air temperature are:

(mA output x 9.375) + (-112.5) = DP or AT in °C

(mA output x 16.875) + (-170.5) = DP or AT in °F

The transfer function for Relative Humidity is:

(mA output x 6.25) -25 = Percentage Relative Humidity

The transfer function for PPM_v will be covered as required by an addendum to the manual.

3.4.5.3 PPM_v (Option 5)

This option provides a range selectable parts per million by volume analog voltage output. The 0-10V signal from the RH COMP™, the X1 multiplier voltage, and the X10 multiplier voltage are used to supply the circuitry which generates the PPM_v output. Jumpers on the option board set the range of the conversion. The PPM_v output can be observed at rear panel plug P20, pin 22. An addendum to the manual is provided to indicate special RH COMP™ programs and PPM_v ranges.

3.5 MODEL 300-RH COMP™ RH COMPUTER OPTION

This option provides the Model 300 Microprocessor Controlled Humidity Analyzer with the capability to display percentage of relative humidity or other outputs based on the dew point and ambient temperature inputs. The dew point data are provided by the Model 300 Sensor and the ambient temperature data are provided by either the Model 300-AT Ambient Temperature Accessory or an externally provided analog input voltage corresponding to temperature. At the same time, an analog output voltage of 0 to +10 VDC is provided at the Model 300 Control Unit output on J20-AJ corresponding to the value of the data calculated by the Model 300-RH COMP™.

Multiplexed 3-Digit BCD data corresponding to the data generated by the Model 300-RH COMP™ are also provided at the rear output connector of the Model 300 Control Unit. These data are provided by Q0, Q1, Q2, and Q3. Q0 is the Least Significant Bit (LSB) of each digit and Q3 is the Most Significant Bit (MSB) of each digit.

Digit Select DS2 goes high to signify that the data on Q0 to Q3 at that moment correspond to digit 2. Similarly, Digit Select Output DS3 indicates when the data on Q0 to Q3 correspond to digit 3. Finally, Digit Select Output DS4 is high for output data for digit 4. Digit Select Output DS1 is not used. Digit 2 is the most significant digit.

The Model 300-RH COMP™ multiplexed digital data should be strobed into external hardware on the leading edge of the appropriate Digit Select signal. The Digit Select lines and output data lines operate between 0 volts and +5 volts DC, but are C/MOS rather than T^2L compatible.

By operation of switch S-21, and the addition of a special Model 300-BC BCD output module, the output of the Model 300-RH COMP™ can be converted to latched T^2L compatible outputs as described in subsection 3.4.3.

3.6 MODEL 300-AT AMBIENT TEMPERATURE ACCESSORY

When equipped with the Model 300-AT Accessory, the Model 300 Microprocessor Controlled Humidity Analyzer will measure the ambient temperature sensed by the remote Platinum Resistance Thermometer (PRT) included in the accessory kit. The PRT cable should be attached to the Model 300 Control Unit rear panel connector J20 in the following manner:

PRT Cable Drain Wire (shield) to J20-E
PRT Cable Red Wire to J20-K
PRT Cable Black Wire to J20-10
PRT Cable White Wire to J20-9

3.7 OPERATING POINT ADJUSTMENTS FOR CONTINUOUS BALANCE CONTROL

The Model 300 Microprocessor Controlled Humidity Analyzer is designed to automatically compensate for variations in operating point conditions such as thickness of the dew layer and the speed of response as determined by gain and compensation considerations. For this reason, there are no adjustment potentiometers that have to be adjusted for this purpose. There are, however, switches provided on the Model 300-CB Continuous Balance Control PWB to allow inputs to be provided to the microprocessor as means of "talking" to it. Normally, the switch potitions of S1, 1 through 8, on

Operation

the CBC PWB will not be changed except under directions from the factory during troubleshooting exercises.

Switch S2 on the CBC PWB has 9 positions. Positions 1 through 8 are used to input data related to the operating mode set point temperature. Position 9 selects the operating mode; closed for normal operation where the instrument controls on the dew/frost point and tracks it continuously, or open for operation whereby the instrument controls the temperature of the mirror surface to match the temperature code selected by switches S2, 1 through 8.

Normal positions for switch S1:

S1-1	Open
S1-2	Open
S1-3	Open
S1-4	Closed
S1-5	Open
S1-6	Open
S1-7	Open
S1-8	Open

Switch S2 can be thought of as a switch having "weighted" inputs for positions 1 through 8. The "weights" for each position are as follows:

	Weight When Open
S2-1	1
S2-2	2
S2-3	4
S2-4	8
S2-5	16
S2-6	32
S2-7	64
S2-8	128

As mentioned previously, S2-9 selects the operating mode. If S2-9 is closed, the positions of S2, 1 through 8, are unimportant. If, however, S2-9 is open, thereby selecting the mirror temperature control mode rather than the dew/frost point control mode, then switch S2, 1 through 8, must be used to input the information related to the temperature at which it is desired to hold the sensor mirror. By closing some switches of S2, 1 through 8, and leaving others open, it is possible to select any "number" from 0 to 255 for input to the microprocessor as the means of informing it of the desired operating temperature. The combination of switches to be closed is determined by arriving at the desired number and then opening only those switches of S2, 1 through 8, that allow the "weighted" switch values to add up to the number selected.

To operate in the temperature control mode of CBC operations, perform the following procedure:

1. Depress the CBC switch to place the instrument in balance and select the temperature at which it is desired to control the sensor mirror temperature in degrees Celsius.
2. Determine the "weighted" switch settings in accordance with the following relationship:

$$\frac{\text{Desired temperature setting in °C + 75}}{0.588} = \text{weighted number}$$

3. Select and open the necessary switches of S2, 1 through 8, such that their total weighted value equals the weighted number determined in Step 2. Leave all other switches of S2, 1 through 8, closed.
4. Open S2-9 to allow the CBC to enter into this special mode of operation. Note that the instrument will enter this mode only when going from the Balance to the Operate mode. Therefore, when the proper value has been selected, release the CBC switch. The temperature set switches S2, 1 through 8, may be changed at any time when operating in this mode and may be used to "tweak" the final temperature set point if desired. When operating in this mode, whereby the sensor mirror temperature is controlled by inputs from S1, 1 through 8, rather than the dew point, the normal functions of the CBC control circuitry continue to function. However, should dew form on the mirror surface when in this mode, the CBC Alarm output will be brought high (+5 volts) at output connector J20-27.

CAUTION

S2-9 should be left closed except when operating in this special mode.

3.8 AUTOMATIC COMPENSATION FOR PRESSURE CHANGES

The Model 300 Microprocessor Controlled Humidity Analyzer measures the vapor pressure of the moisture constituent of the total gas pressure. As explained in Section 7 of this manual, the dew point or vapor pressure measurement is affected by the total pressure of the gas. If the pressure of the gas sample is known and constant, this increase (decrease) in moisture vapor pressure due to the increase (decrease) in total pressure can be accounted for manually or, if the Model 300-RH COMP™ option is employed, a special program can be provided to automatically correct for the fixed pressure other than standard conditions normally inferred. Contact the factory concerning special fixed programs of this nature.

In addition, if the ambient temperature option is not being utilized, the Model 300-RH COMP™ can be programmed to accept an analog input corresponding to pressure and the program will then automatically compensate for changes in the total pressure. This is especially useful when measuring low dew points and the data is being presented in PPM_v. Again, a special program is required to match the transfer function of the pressure analog input. Contact the factory for details. This analog input for pressure, when used, is applied to the output connector on J20-AA. The range of the analog input should not exceed ±1.999 volts DC.

Circuit Description

4.1 BASIC INSTRUMENT BLOCK DIAGRAM DESCRIPTION

Operation of the Model 300 Microprocessor Controlled Humidity Analyzer is best understood by reference to the system block diagram shown in Figure 4-1. (All figures in this section are grouped at the end of the section.)

AC power is applied to the Model 300 Control Unit by means of the AC power cord as shown in the upper left-hand corner of the block diagram. This power source may be either 115 or 230 VAC but must be between 50 and 60 Hz. The AC input power is also applied to an auxiliary AC receptacle, J22, and fused by F2. The auxiliary output is **not** switched and is therefore energized as long as the AC power cord is plugged in. This auxiliary output is useful for powering equipment external to the Control Unit such as a Sample Pump.

The AC power from the power cord is applied to the Main PWB (Figure 4-2) at J/P21. ON/OFF switching occurs in the Switch Matrix (Figure 4-3) on the front panel. Also, 115/230 VAC input selection is made on the Main PWB by means of switch S1.

The Power Supply Panel (Figure 4-4) contains the necessary power transformers for providing isolated, stepped-down voltages for use by the instrument. Also included on the Power Supply Panel are the two large filter capacitors that are used for filtering the DC power used to drive the thermoelectric cooler in the sensor, and miscellaneous SCRs and power resistors. The isolated AC power is rectified and filtered on the Main PWB and is used to provide +15, -15, +5 Logic, +5 Reference, and -4 volts DC for use by the Model 300 circuitry.

At the heart of the Model 300 Microprocessor Controlled Humidity Analyzer is the CBC or Continuous Balance Control circuitry (Figure 4-5). When energized, the CBC PWB controls two light channels in the sensor optical section and can also control the magnitude and direction of the cooling or heating current that flows in the thermoelectric portion of the sensor. The two LED light controls, one for the operate channel and one for the reference or calibrate channel, are controlled directly by the microprocessor CBC and connected via J/P17 and J/P18 to the sensor optical section. In the same manner, the light information received by the single photodetector in the sensor optical section is fed to the CBC PWB for measurement by the microprocessor system.

For sensor thermoelectric cooler control, the CBC controls the inputs to the sensor power supply and, via the Power Supply Panel J/P19, J/P25, and fuse F3, current of the proper amplitude and direction is applied to the sensor base section to either cool or heat the sensor mirror surfaces. By controlling these two light sources, one receiver, and the temperature of the sensor mirror surfaces, the CBC microprocessor causes the system to control with a layer of dew or frost on the primary or wet mirror system. The system then uses the secondary or dry mirror system as a reference or calibrate channel to continuously correct the operate channel for system changes due to particulate matter buildup on the mirror surfaces or component drift that might occur. Figures 4-6 and 4-7 show the details of the two control mirror surfaces and the sensor construction details, respectively.

4.2 CONTINUOUS BALANCE CONTROL SYSTEM

4.2.1 Sensor Design Concepts

To automatically and continuously account for contaminant buildup on the sensor chilled mirror surface, several new concepts in sensor design have been incorporated. One concept places two reflective mirrors in physical proximity to each other, so that each is exposed to precisely the same flow pattern of the gas sample (Figure 4-6). This ensures that gas-borne contaminants will be transported in equal concentrations past both mirror surfaces.

Another concept places the additional mirror in thermal proximity to the other mirror that is normally cooled. By maintaining this thermal proximity, thermal precipitations of the sample contaminants on both "wet" and "dry" mirrors are essentially equal. An important concern in the sensor design was to ensure that the dry mirror surface tracked the wet mirror in temperature, while keeping the dry mirror at a slightly higher temperature. This was necessary to avoid having condensate form on the dry mirror, and to allow contaminant attraction forces for both mirror surfaces to be approximately equal.

A third concept introduces a design that is opposite to previous sensor designs in which two mirror surfaces with one light source and two photodetectors were utilized. This design employs outputs of two LED light sources reflecting from the two closely spaced mirror surfaces into a common photodetector. The use of two LED light sources allows placing the two mirrors close together to meet the physical and thermal proximity requirements. In addition, switching the LEDs allows one photodetector to be used without mixing the two light signals. As discussed later, the secondary or dry channel, acting as a control or reference channel, allows for automatic continuous correction of mirror contaminant buildup, and for any changes in photodetector sensitivity.

Figures 4-6 and 4-7 show the two LED light sources directed to the two mirror surfaces, the two mirror sensor surfaces being approximately 0.25 inch apart. The wet mirror is centrally located on top of a thermoelectric (Peltier) cooling device and is held by means of a copper block that contains a platinum resistance thermometer (PRT) used for measuring the temperature of the wet mirror. The PRT is in thermal contact with the underside of the wet mirror.

A diaphragm, mounted between the wet mirror and the outside wall of the small sample chamber, seals off the bottom of the sample chamber while presenting a very low thermal load to the wet mirror surface.

Other features of the sensor design are the small sample volume: easily removable optical section for access to the mirrors for cleaning, when required; and isolation of all electrical components, LEDs, photodetector, PRT, cooler, and wiring from exposure to the gas sample being measured.

4.2.2 Control System

Figure 4-8, the CBC system block diagram, depicts the control electronics that interface with the sensor to effect the continuous balancing capability. At the center is an INTEL 8085 microprocessor that monitors and controls system operation.

The thermoelectric cooler exhibits a thermal or phase lag, similar to that of an RC low-pass filter. This type of response can cause oscillations in any control loop in which the thermoelectric cooler is a part, unless a phase lead is inserted in the loop for compensation. In addition, depending on the operating dew point, the speed at which dew or frost forms is dependent on the mobility of the condensate, being fast at high dew points and slow at low dew or frost points. This factor is reflected as a change in the gain and phase response of an optical control loop that is dependent, again, on the dew or frost point. The thickness of the dew layer desired also contributes a variable gain and phase response to the system.

Historically, control loop constants for added phase lead, loop gain, and dew layer thickness are adjustments that are manually set for a desired operating point, chosen for stable operation with fast response and no dead band over the operating range anticipated. If it is known that operation will be within a certain dew or frost point range, these adjustments can be manually optimized for that point. However, in the microprocessor controlled, continuously balancing control loop, the operating dew/frost point is measured and used to adjust these control constants to keep optimum settings.

4.2.3 Operation

Upon power turn-on, or by manual activation, the system enters an initialization balance mode. In this mode, both mirror surfaces are heated to ensure that no condensate is present. During this period, the wet and dry LEDs are energized alternately and the output level of the photodetector is measured and compared to a common baseline output. The light intensity of each LED is then independently adjusted by the microprocessor system until the signals detected from both dry mirrors are the same. After a fixed time period, or upon manual activation, the control system will switch to the operate mode.

In the operate mode, both wet and dry channels are still sampled. However, control of the intensity levels of the LEDs is determined only by the level received by the dry, or reference channel. If changes in the light level

Circuit Description

received from the reference mirror channel occur, the light level of the dry channel is adjusted on an incremental basis to restore it to the baseline value. In this operate mode, the light intensity of the wet channel is slaved to the light received from the dry reference channel. Contaminant buildup on the dry mirror causes a reduction in the amount of light received by the photodetector when the dry LED is on. This in turn causes an increase in the DC level used to drive the LED current source. The incremental increase required by the dry channel is also applied to the wet channel. In a similar manner, an increase in the sensitivity of the photodetector causes a corresponding reduction in both wet and dry LED levels to account for the change. Since the photodetection circuitry is common to both channels, any changes are automatically accounted for and corrected on a continuous basis.

The wet channel photodetector output level varies depending on the amount of dew on the wet mirror. Just after initialization, the light output of the wet channel is the same as the output of the dry reference channel. This fact is detected by the microprocessor and is used to make the wet mirror cool at its maximum rate. At the same time, the wet mirror output is being rapidly sampled to determine when condensate forms on the wet mirror. The presence of moisture is detected by a reduction in the output of the wet channel. When this reduction occurs, the dew point temperature is measured and this value is used to determine and set the operating loop parameters of phase lead, gain, and dew layer thickness at their optimum levels, even if the dew or frost point changes. Phase lead, gain, and dew layer thickness are reduced at high dew points and are increased at low frost points as the response of the thermoelectric cooler and the condensate formation change with operating point.

The above system functions on an automatic continuous basis to adjust for changes in mirror conditions due to contaminants, to adjust for loop circuit variations that may occur, and to adjust operating loop parameters to their optimum values regardless of prevailing dew or frost point.

When the system has been operating for extended periods of time and buildup of contaminants on the dry reference channel approaches a point where further correction for this condition will be impossible, a warning signal is generated by the microprocessor to alert the instrument user that normal routine maintenance of the dew point sensor is required and that the sensor mirror and optical surfaces should be cleaned.

Since the dry mirror is operated at a temperature slightly above the temperature of the wet mirror, a step change from a given dew point to a higher dew point could cause condensation to occur on the dry reference channel mirror until the system has had time to respond to the new dew point. If this does occur, it is treated in a manner that does not affect system operation.

In the initialization mode, the wet and dry channels are sampled rapidly and adjusted immediately to the established base levels. However, in the operate mode, only the wet channel is sampled rapidly and used as the input to the control loop. The dry reference channel is sampled at a much slower rate when in the operate mode and, even then, adjustments to the wet and dry light levels are made on an incremental basis for each sample. When moisture condenses temporarily on the dry mirror, when sampled, it causes only a small incremental increase in the light levels of both the wet and dry channels. Generally, by the time the dry channel is sampled again, the system will be controlling at the higher dew point, the condensation will have evaporated from the dry mirror, and a small incremental decrease will be applied to both channels, restoring them to the original operating points. This slower rate of sampling for the dry reference channel at the slower rate does not degrade system operation.

4.2.4 Alternate Operating Mode

On occasion, it is desired to measure moisture levels in gases where the presence of moisture on the mirror surfaces will form an acid, and the vapor pressure of the acid will be different from that of the water vapor alone. Two such gases are chlorine and hydrogen sulfide, which form HCl and H_2SO_4, respectively, on the mirror surface. Generally, when using these gases, the main concern is that the moisture level not exceed a certain point. Other applications require that the moisture not exceed a certain concentration, with little concern if it is below that level and the actual moisture level is not important. For these applications, the microprocessor can be instructed to operate on a different program that forces the temperature of the wet mirror to be controlled at a fixed input: for instance, -60°C. This input is adjustable by the operator over the full operating range of the instrument. In this mode, the temperature of the wet mirror is held at -60°C, and as long as the frost point of the sample gas is lower than -60°C, no condensation will occur on the wet mirror. However, automatic corrections for contaminant buildup continue to be supplied to account for any changes in mirror or circuit conditions. If the frost point increases above -60°C, the presence of condensation on the wet mirror will cause the microprocessor to output the alarm signal to indicate to an operator that corrective action should be taken.

4.2.5 Other Circuits and Options

With the CBC circuitry operating continuously to maintain the sensor mirror temperature at the proper dew or frost point temperature, the remaining circuitry and the options available for the Model 300 Microprocessor Controlled Humidity Analyzer serve to measure the dew or frost point temperature and modify it if desired and present it for display and for use by external recording instrumentation. Referring again to Figure 4-1, the PRT Amplifier plugged into J5 serves to independently measure the resistance of the PRT located just beneath the sensor wet mirror and convert this resistance to an analog voltage proportional to the temperature of the sensor wet mirror. This analog voltage, -7.5 volts to +7.5 volts, corresponding to sensor wet mirror temperatures of -75°C and +75°C, is applied to the Track and Hold and Alarm (Sensor Diagnostics) PWB (Figure 4-9) plugged into J7. In addition, this signal, in either its direct or Track and Hold output form, is applied to the MUX and ADC PWB (Figure 4-10) plugged into J3A and J3B on the Main PWB.

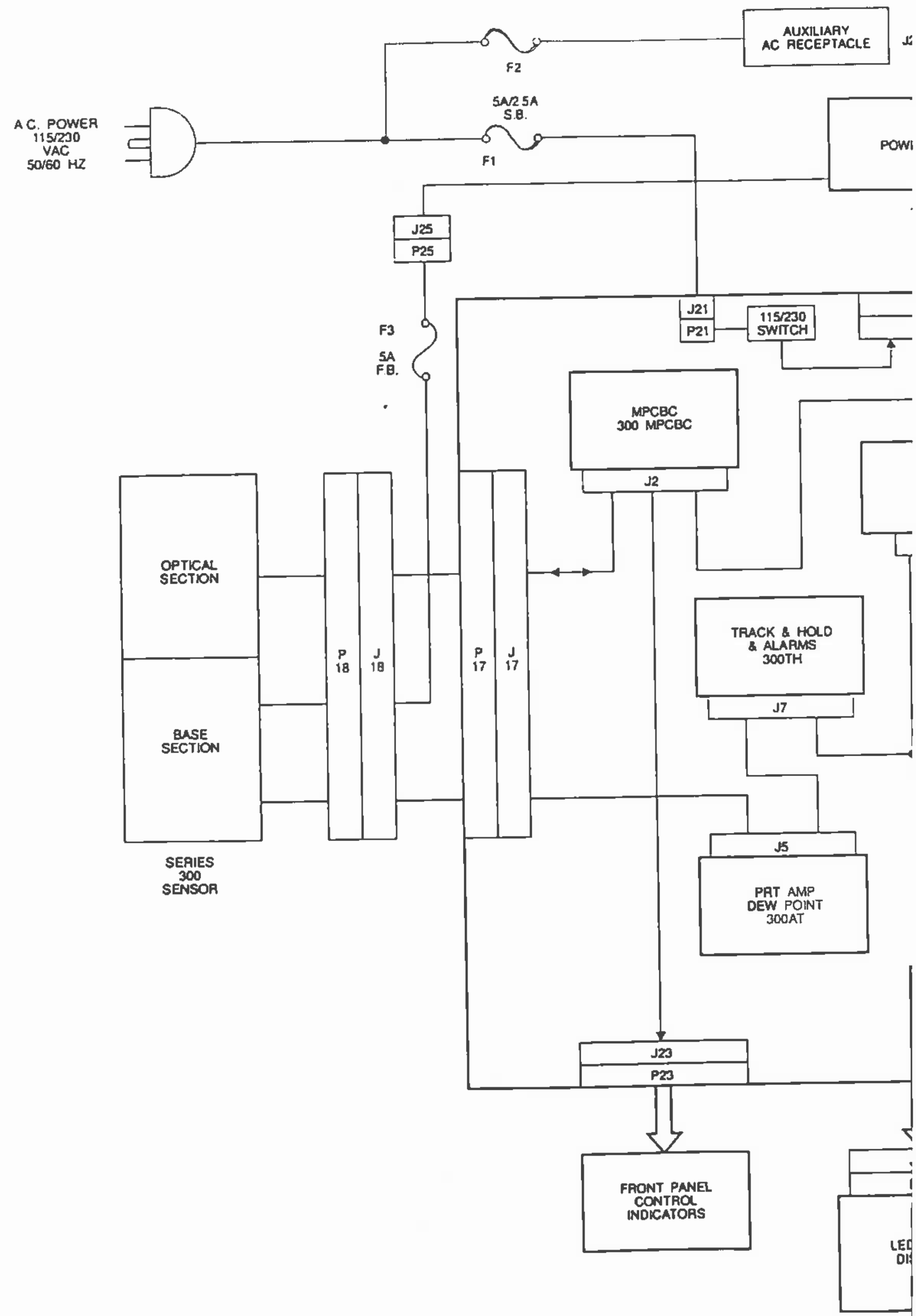
The MUX and ADC PWB multiplexes several input channels of data into one ADC (Analog to Digital Converter). The output of the ADC is multiplexed BCD data corresponding to the analog input voltage presented at its input. Various input voltages that can be measured by the ADC include dew point °C and °F and ambient temperature °C and °F. The multiplexed BCD data are made available to the Display Driver Circuitry as well as to the Model 300-BC BCD option at J9, the Model 300-RD Secondary Readout Display Option at J16, and the Model 300-RH COMP™ Option at J1.

The Model 300-AT Ambient Temperature Accessory includes a PRT Amplifier Card that is interchangeable with the one used for converting the sensor PRT resistance to a voltage. The AT PRT AMP is plugged into J6, whereas the sensor PRT AMP is plugged into J5. Both perform the same function for their respective PRTs.

The Model 300-CF Degrees Celsius to Degrees Fahrenheit Converter, plugging into J4, converts analog voltage inputs corresponding to °C to analog voltages corresponding to °F. Two identical channels are provided on this plug-in PWB, and the °F analog outputs appear at the output simultaneously with the °C analog outputs.

The Model 300-RH computes relative humidity, parts-per-million by volume, or grains; displays the computation results; and provides a corresponding 0 to 10 volts analog output. RH models process dew point and air temperature to compute relative humidity. PPM_v and Grain models compute parts-per-million by volume or grains from dew point. PPM_v models may additionally compute pressure corrected PPMs by the addition of an optional pressure interface card at J6 and a remote pressure transducer. Additionally, PPM models generate the signals which result in the X1, X10, and X100 front panel display multipliers.

Additional output functions are provided by the Alarm, mA, PPM_v analog card. The PPM_v analog circuit processes the RH module's 0 to 10 volts signal and the X1, X10 display multipliers to generate a zero to 100, 1000, or 10,000 PPM_v analog output of 0 to 10 volts. Alarm and mA circuits process switch selectable analog inputs of dew point, air temperature, RH (from RH computer), or PPM_v. The alarm circuit compares the input analog to the adjustable set point to operate the isolated output relay contacts. The mA circuit generates either isolated or nonisolated 4-20 mA analog output signals proportional to the selected input.


AUXILIARY
AC RECEPTACLE
F2
5A/2.5A
S.B.
A.C. POWER
115/230
VAC
50/60 HZ
F1
POW
J25
P25
F3
5A
F.B.
J21
P21
115/230
SWITCH
MPCBC
300 MPCBC
J2
OPTICAL
SECTION
BASE
SECTION
SERIES
300
SENSOR
P
18
J
18
P
17
J
17
TRACK & HOLD
& ALARMS
300TH
J7
J5
PRT AMP
DEW POINT
300AT
J23
P23
FRONT PANEL
CONTROL
INDICATORS

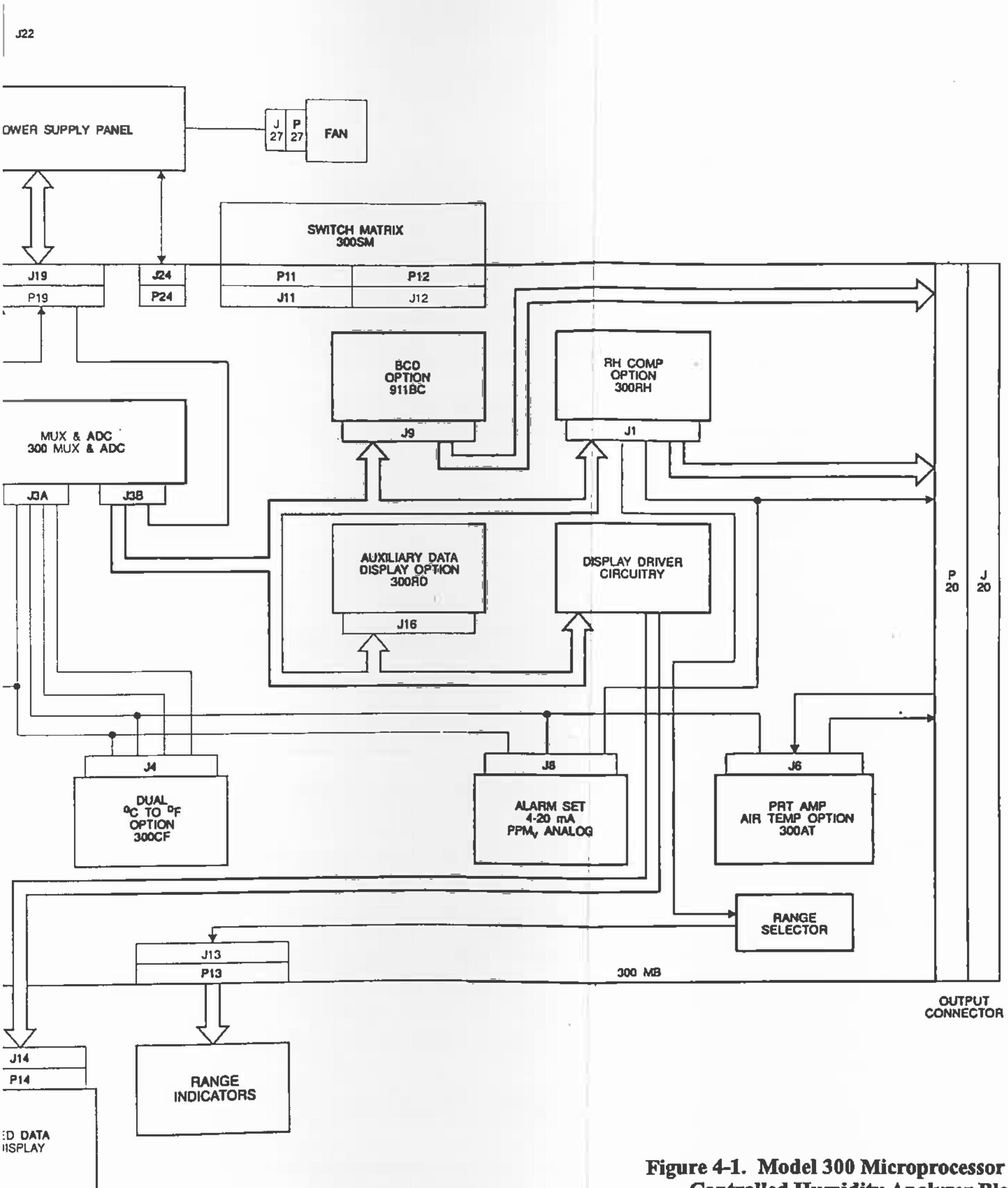


Figure 4-1. Model 300 Microprocessor Controlled Humidity Analyzer Block Diagram.

Circuit Description

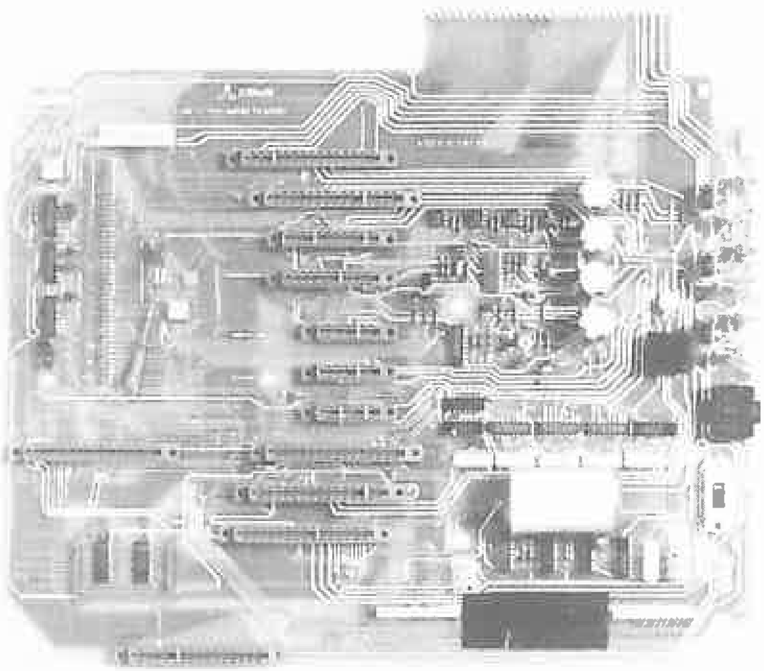


Figure 4-2. Model 300 Main PWB.

Figure 4-3. Model 300 Front Panel Switch Matrix.

Circuit Description

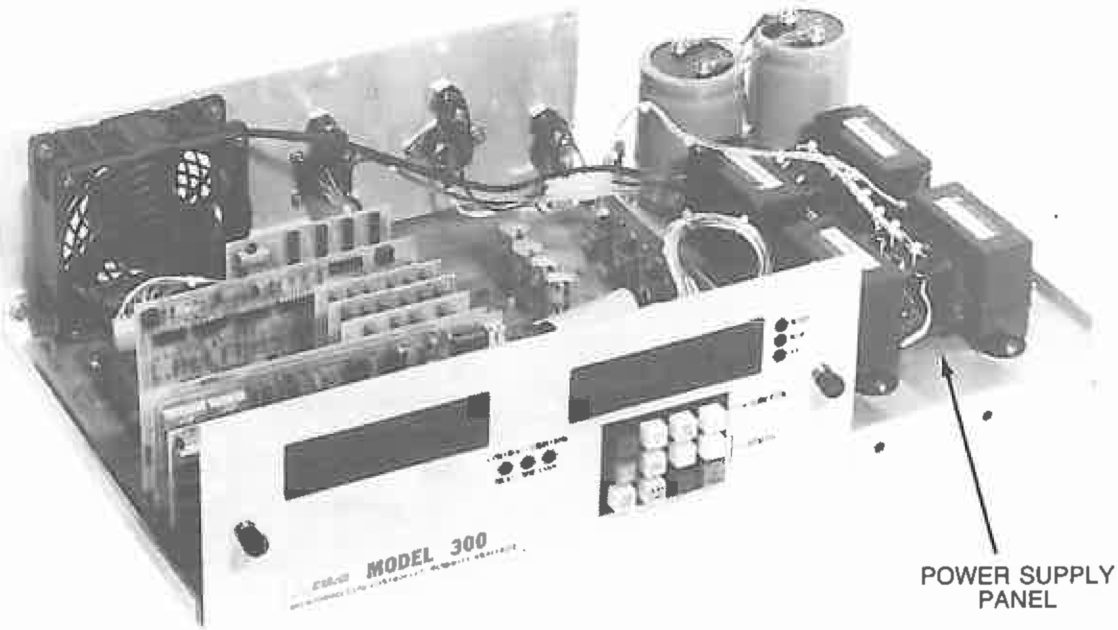


Figure 4-4. Model 300 Power Supply Panel.

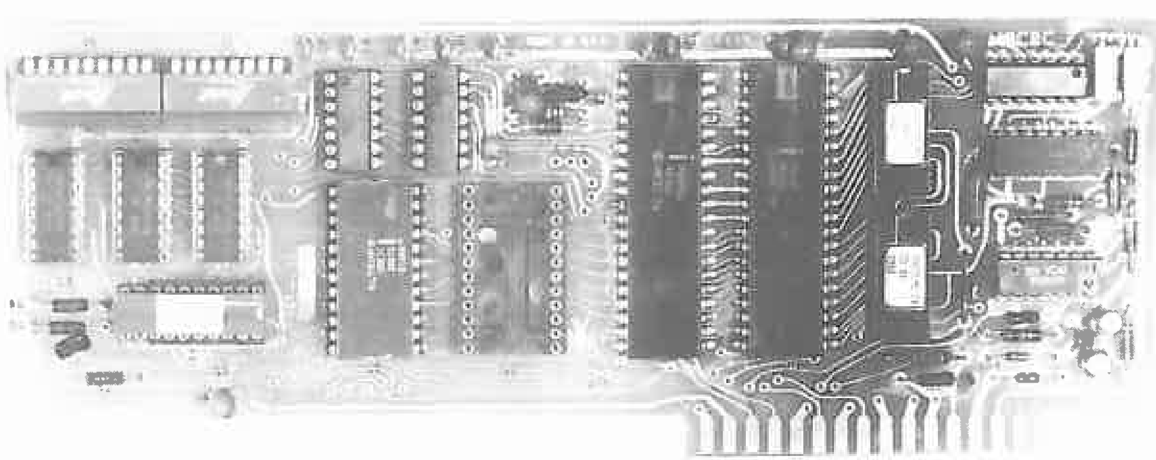


Figure 4-5. Model 300 Continuous Balance Control Circuitry.

Circuit Description

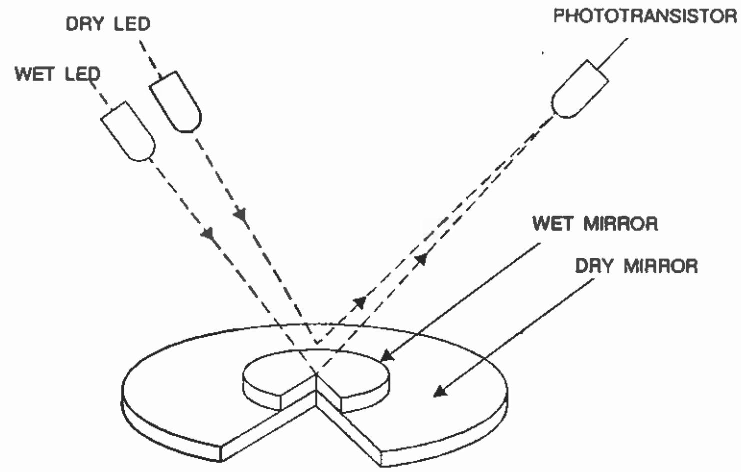


Figure 4-6. Sensor Dual Mirror Details.

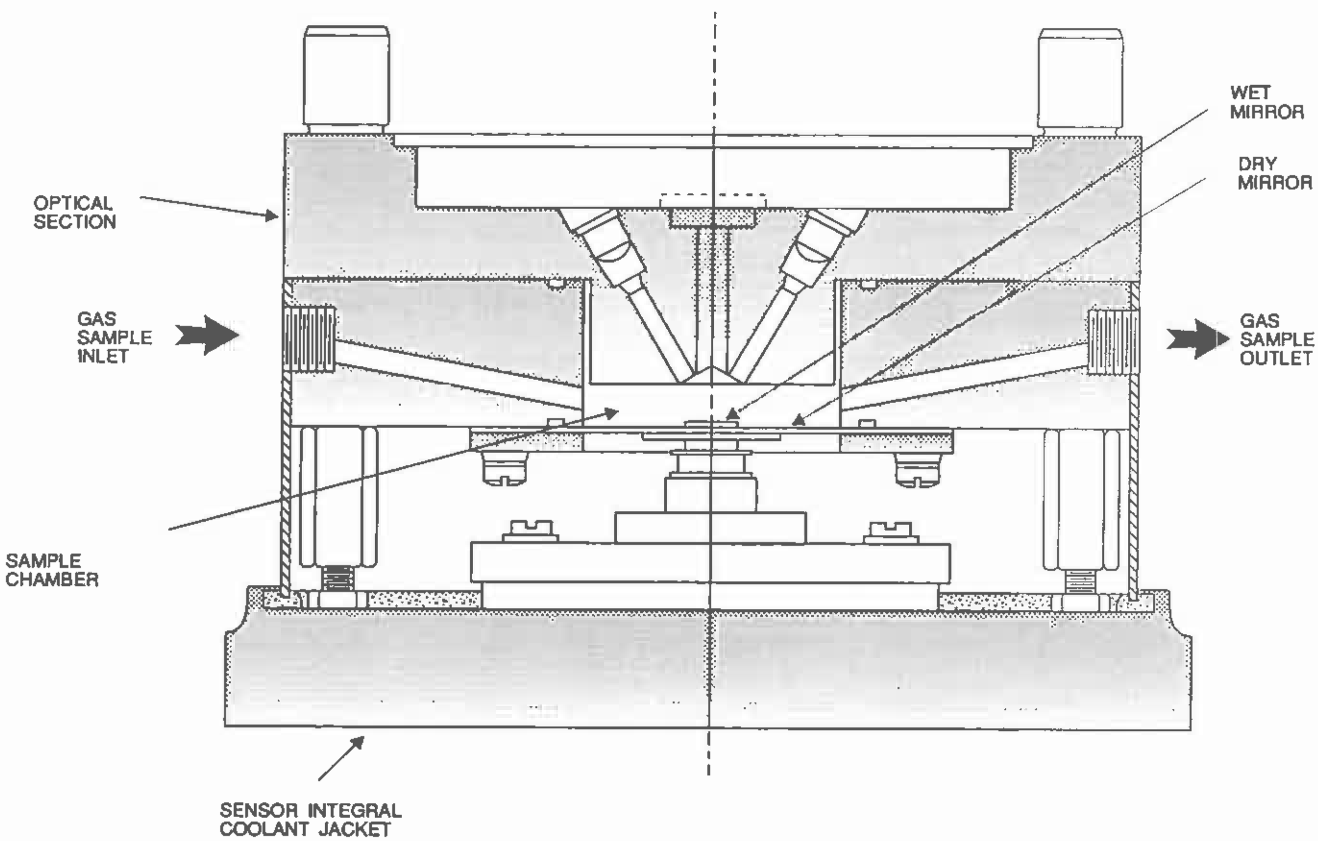


Figure 4-7. Sensor Construction Details.

Circuit Description

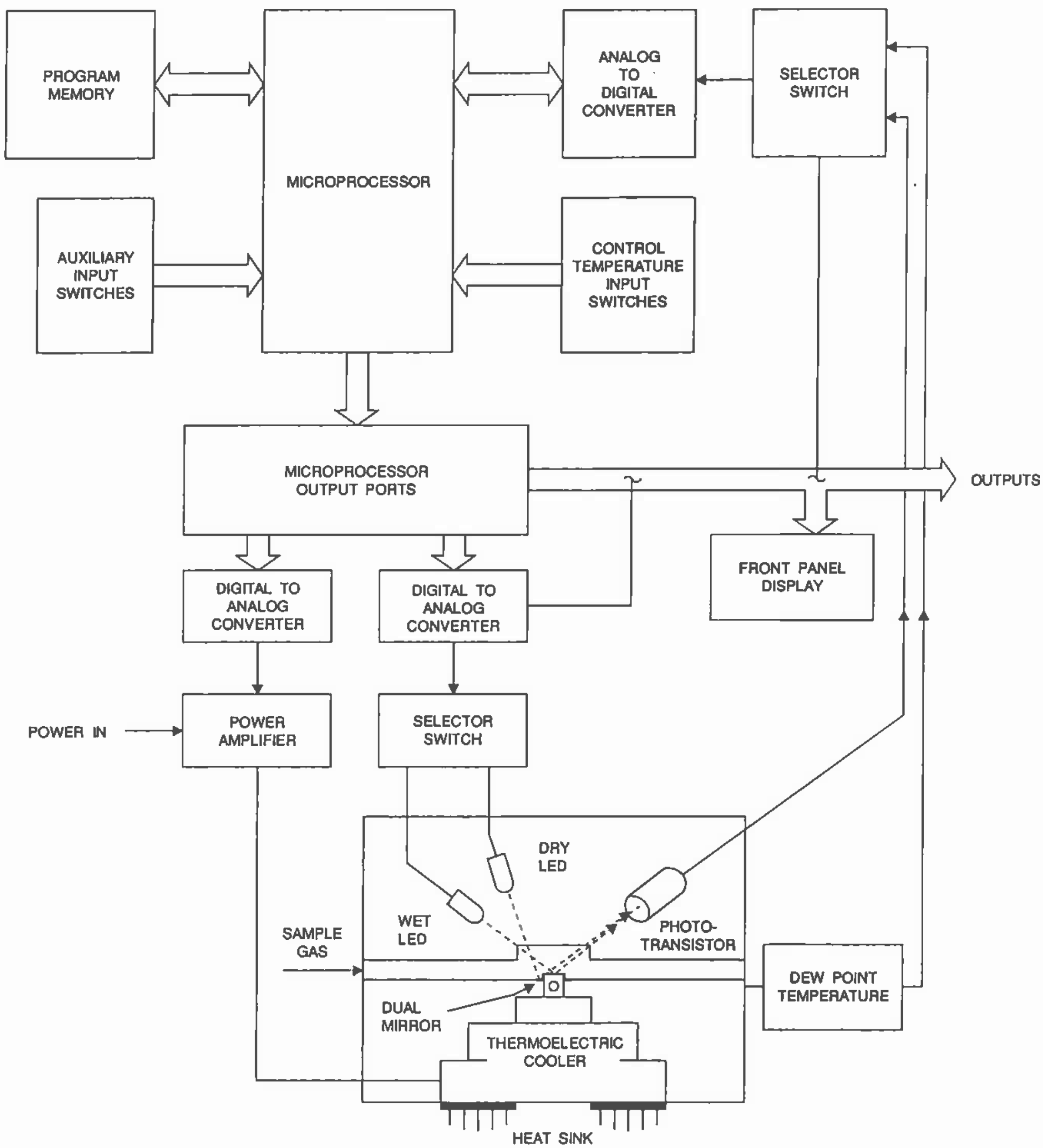


Figure 4-8. Model 300 Continuous Balance Control System Block Diagram.

Circuit Description

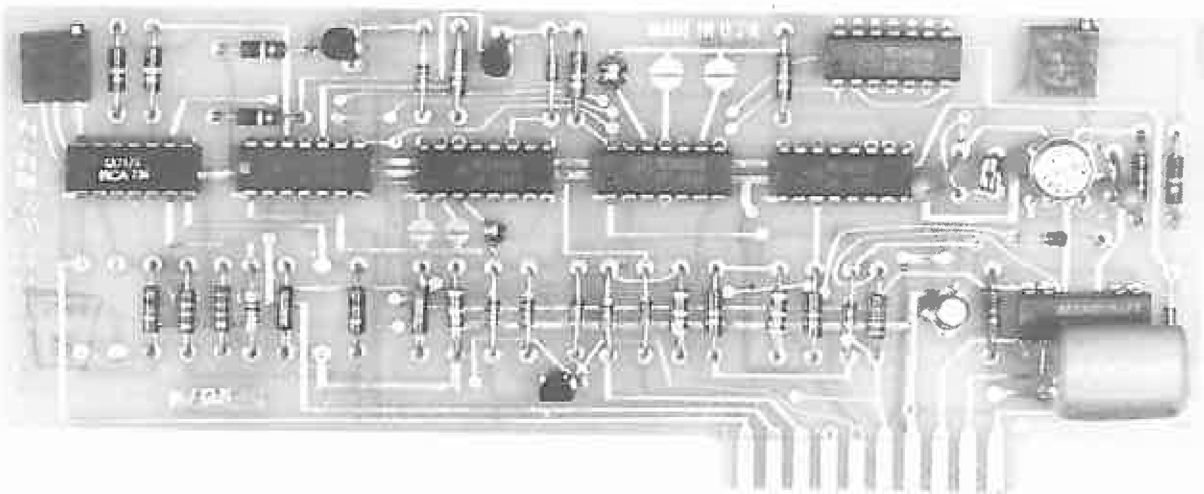


Figure 4-9. Model 300 Track and Hold and Alarm PWB.

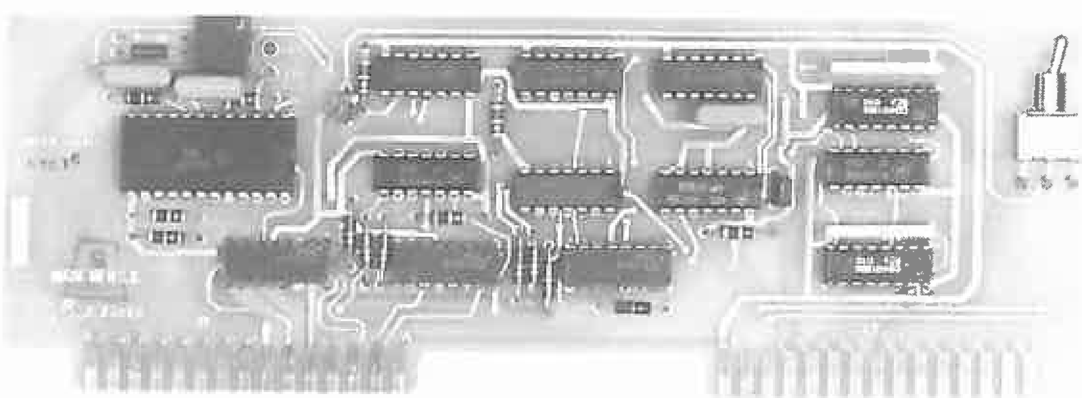


Figure 4-10. Model 300 MUX and ADC PWB.

Interpretation of Data

5.1 DESCRIPTION OF OUTPUT DATA

The Model 300 Microprocessor Controlled Humidity Analyzer measures the dew/frost point of the gas sample flowing through the Model 300 Sensor. This measured data is displayed on the front panel primary digital display and is also provided at rear panel connector J20 in analog form. The front panel primary display also indicates the type of data being displayed; the character following the decimal digits is used to describe the data being displayed at any given time.

°C Indicates temperature in degrees Celsius*

°F Indicates temperature in degrees Fahrenheit*

H Indicates percentage of relative humidity or PPM

□ Indicates Grains or some other special customer specified output.

NOTE

Both H and □ symbols represent the output of the Model 300-RH COMP™ option.

5.2 OUTPUT DATA BELOW 0°C (32°F)

At sensor primary mirror temperatures below 0°C (32°F), the water on this mirror surface can be ice or supercooled liquid. Generally, it is in the form of supercooled liquid only for a short time, i.e., when the temperature is not far below the freezing point, but, eventually, it transits to ice. This fact is significant because, for a given gas sample with fixed vapor content, the temperature at which a surface of ice must be maintained to be in equilibrium with the water vapor is slightly higher than that for water. Dew Point/Frost Point relationships in both metric units (°C) and English units (°F) are shown in Section 7 of this manual.

*The Model 300-RD Secondary Readout Display will display only dew point or ambient temperature data; therefore, the character following the data is limited to °C or °F.

5.3 OUTPUT DATA AT PRESSURES OTHER THAN ATMOSPHERIC

In a gas system where the sample goes through a pressure change, provided there is no condensation due to the change, the change in water vapor pressure is proportional to the total pressure change and can be calculated from Dalton's law accordingly:

$$e_2 = e_1 \sim \frac{P_2}{P_1}$$

where e_2 is the partial pressure of water vapor at total pressure P_2, and e_1 is the partial pressure of water vapor at total pressure P_1. There is a one-for-one correspondence between the partial pressure of water vapor (e) and the dew point temperature (Smithsonian Meteorological Tables).

A useful approximation is:

$$\Delta TD = 14 \frac{\Delta P}{P}$$

where ΔTD is the change in dew point temperature (°C) due to a change in sample pressure, ΔP is the change in sample pressure, and P is the sample pressure. Thus, a 10% change in pressure

$$\frac{\Delta P}{P} = \frac{1}{10}$$

will result in about a -1.4°C change in the dew point temperature.

5.4 ANALOG OUTPUT DATA

All analog outputs from the Model 300 Microprocessor Controlled Humidity Analyzer are of the low impedance type, the output of an operational amplifier. The AT Analog Output, -7.5 to +7.5 VDC, also serves as an external analog input line when external temperature data or external pressure analog information are provided by the customer.

The maximum load impedance should be greater than 10K for best results. If the cable lengths from the Model 300 outputs to the recording or monitoring equipment are long, the recording or monitoring equipment should be of the high input impedance type to reduce to a negligible amount any signal loss in the interconnecting cable due to current flow.

Maintenance

6.1 GENERAL

The Model 300 Microprocessor Controlled Humidity Analyzer requires little maintenance due to its almost 100% solid state design. The only components requiring periodic maintenance are the sensor mirror and optical components and the Control Unit fan cooling system.

The Model 300 Sensor Cleaning Kit is shipped with each instrument. The Cleaning Kit consists of a small bottle of EG&G Type A cleaning fluid and a package of cotton swabs.

6.2 PERIODIC MAINTENANCE

6.2.1 Model 300 Sensor Cleaning—When to Clean the Sensor

The Model 300 Sensor incorporates optical sensing devices and must therefore be maintained at some minimum level of cleanliness. The frequency of sensor cleaning required for proper operation will vary widely with sampling conditions; the cleanliness of the sample, the flow rate, and the type of contaminants. Normally, cleaning of the sensor can be ignored until a signal is given by the CLeaN MIRror indicator on the front panel of the instrument. If this indication appears, the CBC switch should be turned on as soon as is reasonably possible and the sensor mirror cleaned. If, after a period of about 90 days, the front panel indicator has not indicated that cleaning is necessary, it is a good practice to perform preventive maintenance and schedule the sensor mirror and optical components for cleaning on a routine basis.

6.2.2 Model 300 Sensor Cleaning—How to Clean the Sensor (Figure 6-1)

When it is determined that cleaning of the Model 300 Sensor is required, proceed as follows:

1. If the instrument is operating, turn on the CBC switch on the front panel. The CBC switch should begin to flash, indicating that the Track and Hold feature has entered the Hold mode and is now remembering (holding) the dew point analog data just prior to initiating this sensor cleaning operation.
2. Ensure that all sample line pressure is removed from the sensor, if present, and unscrew the two large screws that attach the sensor optical section to the sensor base section. These screws are captive and will not fall out or get lost.
3. Slowly remove the optical section from the base section by pulling outward with a gentle rocking motion, while observing the location of the "O" ring between the two sections.

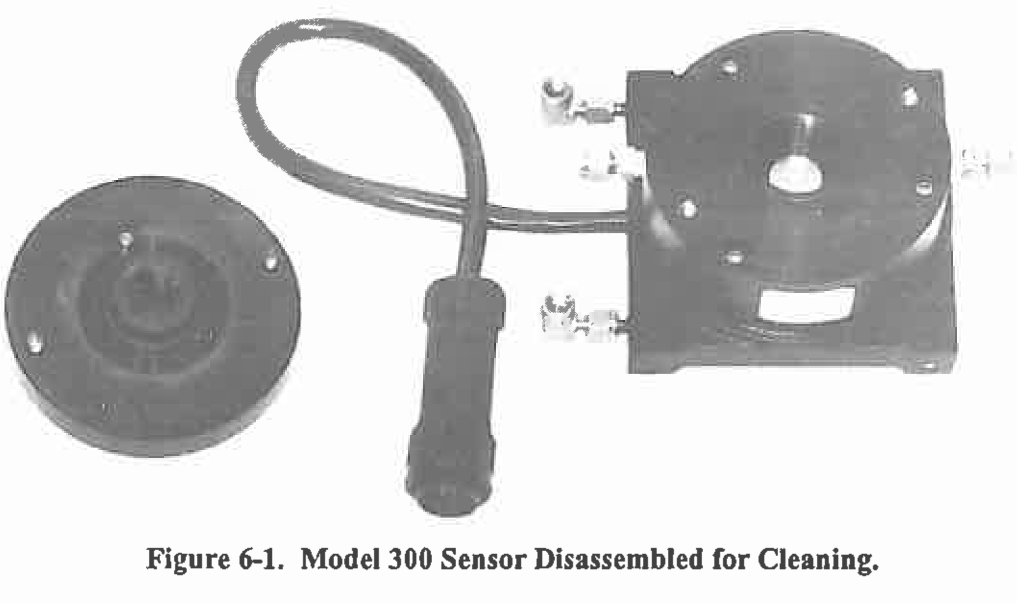


Figure 6-1. Model 300 Sensor Disassembled for Cleaning.

4. The optical section will come free of the base section and should be examined for evidence of any foreign substances. Using a dry cotton swab, carefully clean all exposed optical surfaces. In some sensors, these optical surfaces will be the ends of two fiber optic light pipes and a glass lens in front of the photodetector. In other sensors, designed to accept a microscope option, cleaning of the optical section is accomplished by carefully cleaning one flat piece of optical glass.

5. The two-mirror system in the base section of the sensor should be cleaned by using a cotton swab that has been dipped in EG&G Type A cleaner and shaken so that no free liquid of the cleaner is available. Clean both the primary mirror in the center and the silvery concentric secondary mirror that surrounds it. Isopropyl alcohol may be used for cleaning if Type A cleaner is not available. Wipe both mirrors dry with a clean, dry cotton swab afterwards.

NOTE

Use care to avoid scratching the mirror surfaces. Also, do not allow liquid cleaner to run in along the edges of the sample chamber.

6. Examine the "O" ring for nicks and clean the "O" ring groove if required. Replace the "O" ring if necessary. Apply a light film of silicone grease (GE624 or equivalent) to the clean "O" ring before reassembly of the optical section to the base section.

7. Replace the optical section on the base section of the sensor, taking care to align the dowel pin that serves as orientation and protection for the connector between the two sections. Retighten the hold-down screws.

8. After at least 15 seconds, turn off the CBC switch on the instrument front panel by pushing it in. The CBC switch will continue to flash, indicating that the Track and Hold feature is still in the Hold mode. Operation will continue automatically.

6.2.3 Control Unit Cleaning

The Model 300 Microprocessor Controlled Humidity Analyzer utilizes a fan located on the rear panel of the instrument to both remove heat from some of the power supply components and, when the sensor is mounted on the rear of the chassis cover, remove heat from the base of the sensor if no sensor coolant is used. The air intake is on the right-hand side of the chassis cover and the exhaust is at the rear of the instrument, directed at the base of the sensor if so mounted. Therefore, depending on the cleanliness of the atmosphere surrounding the Model 300 Control Unit, it is advisable to clean dust from the objects that are in the path of the major airflow. This would not be necessary more than once per year except in extremely dirty environments. To accomplish this cleaning task, proceed as follows:

1. Shut the system down and remove the chassis from the chassis cover following directions as given in Section 2 of this manual.

2. If the sensor has been mounted on the rear of the chassis cover with the exhaust of the fan blowing on it, remove all dust from the bottom of the base section of the sensor.

3. Using a light brush and a vacuum cleaner, remove all the dust that may have collected on the air inlet holes on the right-hand side of the chassis cover.

4. Again, using a light brush and a vacuum cleaner, dust off and clean all parts of the Power Supply Panel and the inlet and exhaust finger guards on the fan.

5. After cleaning, reassemble the instrument and replace in service.

6.3 DEW POINT AND AMBIENT TEMPERATURE PRT AMPLIFIER ADJUSTMENT PROCEDURE

A Platinum Resistance Thermometer (PRT) is used in the Model 300 Dew Point Sensor and the Ambient Temperature Accessory. To measure the temperature, the PRT resistance is converted to a voltage by a PRT Amplifier. This amplifier contains controls for ZERO, SPAN, and LINEARITY. By adjustment of these controls, the PRT Amplifier can be made to produce a linear output voltage proportional to the temperature sensed by the PRT. These adjustments are made at the factory and normally do not have to be changed. However, large changes in cable lengths used to mount the dew point or ambient temperature sensors remotely may require readjustment (there is approximately a 0.1°C change in output for a 50-foot change in cable length). Factory adjustments are made based on cable lengths specified at time of purchase. If it becomes necessary to check the operation of the PRT amplifier for calibration purposes or if the remote cable length is changed significantly after shipment from EG&G, then the following procedure should be used. A precision calibrated resistance decade box and precision calibrated Digital Volt Meter (DVM) are required for making these adjustments.

A plug-in PRT amplifier card is used to convert the resistance of the PRT to an analog voltage. One is used for dew point temperature and another one is provided if the Model 300-AT Accessory is purchased.

The adjustment procedure is identical for both dew point and ambient temperature PRT PWBs. However, connection of the precision resistance decade box and the location for monitoring of the analog voltages are different.

The PRT Amplifier PWBs used for the measurement of dew point and ambient temperature look identical but may have been calibrated for different values of PRT constants. Care should be taken not to interchange these boards, if two are supplied, without noting the serial numbers to ensure that they are returned to their proper locations (Dew Point—J5; Ambient Temperature—J6).

6.4 PRT AMPLIFIER CALIBRATION

6.4.1 Attachments for Dew Point PRT Amplifier Calibration

1. Disconnect the sensor from the rear of the Model 300 Control Unit or from the far end of its remote cable if an interconnecting cable is used.
2. Attach a 2-terminal precision decade box to 3 leads of the end of the cable or the rear panel connector as follows:

   High terminal of decade box to J18-D.
   Low terminal of decade box to J18-E.
   Low terminal of decade box to J8-F.

3. Attach a precision Digital Volt Meter (DVM) to the Model 300 Control Unit rear panel connector J20-25 (+) and J20-A (-).

6.4.2 Attachments for Ambient Temperature PRT Amplifier Calibration

1. Disconnect the ambient temperature sensor from rear panel connector J20 of the Model 300 Control Unit.
2. Attach a 2-terminal precision decade box to the 3 pins of J20 from which the ambient temperature sensor was removed as follows:

   High terminal of decade box to J20-K (Red wire).

   Low terminal of decade box to J20-9 (White wire).

   Low terminal of decade box to J20-10 (Black wire).

3. Attach a precision Digital Volt Meter (DVM) to J20-AA (+) and J20-A (-).

6.4.3 Calibration Procedure

The dew point PRT amplifier is located in J5 and the ambient temperature PRT amplifier is located in J6.

NOTE

For convenience, when both the dew point sensor and the ambient temperature sensor are being calibrated, the ambient temperature PRT amplifier may be calibrated by inserting it into J5 and using the setup for calibration of dew point. Thus calibrated, it can then be reinserted into J6. This is especially useful to preclude the necessity of having to unsolder the AT cable from rear panel connector J20, and also if the ambient temperature sensor has a cable greater than 10 feet in length.

1. Set the precision decade resistance box to 100.00 ohms.* Adjust ZERO potentiometer R27 on the PRT AMP PWB being calibrated until the appropriate analog output voltage as measured with the DVM equals 0.000 VDC (0°C).
2. Set the decade box to 111.79* ohms and adjust SPAN potentiometer R2 until the DVM indicates +3.000 VDC (+30°C).
3. Set the decade box to 123.48* ohms and adjust LIN potentiometer R25 until the DVM indicates +6.000 VDC (+60°C).
4. Repeat steps 1, 2, and 3 above until all conditions are met. Since the functions of the adjustments interact to a degree with each other, it may be necessary to repeat these steps several times.
5. Set the decade box to 84.11* ohms. The output should indicate -4.000 VDC ±0.005 VDC (-40°C).

6.5 DIAGNOSTIC TESTING USING THE DVM

The Model 300 Microprocessor Controlled Humidity Analyzer has been designed to allow the user to utilize the digital display functions of the instrument as a 3-1/2 digit Digital Volt Meter (DVM) when necessary for troubleshooting purposes. Although this feature should not be used for such precise purposes as calibration of the dew point and PRT amplifiers, it can be useful as a troubleshooting aid for those instances when trouble in the instrument may be apparent and a separate test DVM may not be readily available.

In order to use the digital display as a DVM, slide the chassis out from the chassis cover to expose the "Grabber" test hook that is clipped to a test point on the left-hand side of the Main PWB. By removing this test hook from its test point, it can be used to attach to other parts of the circuit cards to measure voltages that can assist in locating the source of problems. Following such testing, the "Grabber" must always be returned to its original location and the chassis secured in the chassis cover.

When attempting to use the digital display as a DVM, dew point temperature must be selected for display. In addition, the decimal point must be mentally moved one place to the left to obtain the correct DC voltage reading, i.e., 50.0 = 5.00 volts DC. This DVM feature is operable only for DC voltages less than 19.99 volts.

It is possible that the only time this feature will be used is when discussing a field problem with the factory. During these times, the factory service representative may request that certain voltages be measured and reported as a means of isolating a problem, and as an aid in determining if a failed instrument can be repaired in the field or must be returned to the factory for service.

If an accidental short occurs on the output of any of the DC supplies while attempting to measure them with the "Grabber," they will turn off rather than supply current to the short circuit. When the short is removed, the DC supplies may be reset by turning OFF the AC power to the instrument for a few seconds and then turning it ON again.

*Nominal values. Check data sheet provided with certificate of calibration if values for calibration are other than above values.

General Dew Point Measurement Information

7.1 BASIC HUMIDITY DEFINITIONS

7.1.1 Dalton's Law

John Dalton was the first to surmise that the total pressure, P_m, exerted by a mixture of gases or vapors is the sum of the pressures of each gas if it were to occupy the same volume by itself. The pressure which each gas component of a multiple constituent gas (such as air) exerts is called its **partial pressure.** If P_x, P_y, and P_z represent the respective partial pressures of gases X, Y, and Z in a mixture, Dalton's Law states:

$$P_m = P_x + P_y + P_z + \ldots$$

Elementary as it may seem, the concept of Dalton's Law is often overlooked in considering problems in humidity, because one forgets that the "water" in a gas is actually a gas itself and must be treated in accordance with the gas laws. Air must be considered a mixture of gases—oxygen, nitrogen, and water vapor (neglecting the minor constituents). All discussions of humidity can then be reduced to discussions of water **vapor pressure,** and all definitions encountered in humidity can be expressed in terms of **vapor pressure.**

7.1.2 Dew Point and Frost Point

Dew Point is that unique temperature to which the air (or any gas) must be cooled in order that it be saturated with respect to **water.** Frost Point is that unique temperature to which the air (or any gas) must be cooled in order that it be saturated with respect to **ice.**

The Dew Point or Frost Point DEFINES the partial pressure of the water vapor in a gas, from the Smithsonian Meteorological Tables.

7.1.3 Relative Humidity

Relative Humidity is the ratio of the actual vapor pressure in the mixture to the saturation vapor pressure, **with respect to water,** at the prevailing dry bulb temperature.

Example 1. (Metric Units)

If dew point = 10°C and dry bulb = 25°C:

$$RH = \frac{\text{Vapor Pressure at 10°C}}{\text{Vapor Pressure at 25°C}}$$

$$= \frac{12.272 \text{ mb}}{31.671 \text{ mb}} = 38.7\%$$

If frost point = -45°C
and dry bulb = -40°C:

$$RH = \frac{\text{Vapor Pressure at -45°C (Actual)}}{\text{Vapor Pressure at -40°C (with respect to water)}}$$

$$= \frac{0{:}07198 \text{ mb}}{0.1891 \text{ mb}} = 38.1\%$$

Example 2. (English Units)

If dew point = 50°F and dry bulb = 90°F:

$$RH = \frac{\text{Vapor Pressure at 50°F}}{\text{Vapor Pressure at 90°F}}$$

$$= \frac{0.3624 \text{ in. Hg}}{1.422 \text{ in. Hg}} = 25.5\%$$

If frost point = -50°F
and dry bulb = -40°F:

$$RH = \frac{\text{Vapor Pressure at -50°F (Actual)}}{\text{Vapor Pressure at -40°F (with respect to water)}}$$

$$= \frac{1.990 \times 10^{-3} \text{ in. Hg}}{5.584 \times 10^{-3} \text{ in. Hg}} = 35.7\%$$

NOTE

RH is arbitrarily defined with respect to water even though it seems that it should be with respect to ice at -40°C (-40°F).

7.1.4 PPM by Volume

Parts per million (PPM) by volume is the ratio of the partial pressure of the water vapor to the partial pressure of the dry gas.

Example 1. (Metric Units)

If frost point = -60°C and system total pressure is 1013 mb (14.7 psia)

$$PPM_V = \frac{\text{Parts}}{\text{Million}}$$

$$= \frac{\text{Vapor Pressure at -60°C}}{\text{Total Pressure—Water Vapor Pressure at -60°C}}$$

$$= \frac{10.80 \times 10^{-3}\ \text{mb}}{(1013 - 10.80 \times 10^{-3})\ \text{mb}} \times 10^6$$

$$= 10.7\ \text{PPM (by volume)}$$

Example 2. (English Units)

If frost point = -70°F and system total pressure is 14.7 psia (29.92 in. Hg):

$$PPM_V = \frac{\text{Parts}}{\text{Million}}$$

$$= \frac{\text{Vapor Pressure at -70°F}}{\text{Total Pressure—Water Vapor Pressure at -70°F}} \times 10^6$$

$$= \frac{4.974 \times 10^{-4}\ \text{in. Hg}}{(29.92 - 0.004974)\ \text{in. Hg}} \times 10^6$$

$$= 17\ \text{PPM (by volume)}$$

7.1.5 PPM by Weight

PPM by weight of dry gas is identical to PPM by volume except that the weight ratio changes with the molecular weight of the carrier gas.

Example 1. (Metric Units)

If frost point = -60°C, system total pressure is 1013 mb, and the carrier gas is hydrogen:

$$PPM_w = PPM_v \times \frac{\text{Mol. wt. of } H_2O}{\text{Mol. wt. of carrier gas}}$$

$$= 10.7 \times \frac{18}{2} = 96.3\ \text{PPM (by weight)}$$

Example 2. (English Units)

If frost point = -70°F, system total pressure is 14.7 psia, and the carrier gas is hydrogen:

$$PPM_w = PPM_v \times \frac{\text{Mol. wt. of } H_2O}{\text{Mol. wt. of carrier gas}}$$

$$= 17 \times \frac{18}{2} = 153\ \text{PPM (by weight)}$$

7.1.6 Molecular Weight of Common Gases

Acetylene	26	Helium	4
Air	29	Hydrogen	2
Ammonia	17	Methane	16
Argon	40	Nitrogen	28
CO_2	44	Oxygen	32
CO	28	Sulfur Dioxide	64
Ethylene	28	Water	18

7.1.7 Dew Point/Frost Point Relationships

Below 0°C (32°F), dew point hygrometers measure the frost point temperature rather than the dew point. The tables below permit conversion from dew to frost point. For a more accurate conversion, consult Table 102 of the Smithsonian Meteorological Tables.

Metric Units (°C)

F.P.	D.P.	F.P.	D.P.	F.P.	D.P.	F.P.	D.P.
0	0	-12	-13.4	-24	-26.6	-36	-39.4
- 1	- 1.2	-13	-14.5	-25	-27.7	-37	-40.5
- 2	- 2.3	-14	-15.6	-26	-28.8	-38	-41.6
- 3	- 3.4	-15	-16.7	-27	-29.9	-39	-42.6
- 4	- 4.5	-16	-17.8	-28	-30.9	-40	-43.7
- 5	- 5.6	-17	-18.9	-29	-32.0	-41	-44.7
- 6	- 6.8	-18	-20.0	-30	-33.0	-42	-45.8
- 7	- 7.9	-19	-21.1	-31	-34.1	-43	-46.8
- 8	- 9.0	-20	-22.2	-32	-35.2	-44	-47.9
- 9	-10.1	-21	-23.3	-33	-36.2	-45	-49.0
-10	-11.2	-22	-24.4	-34	-37.3	-46	-50.0
-11	-12.3	-23	-25.5	-35	-38.4		

General Dew Point Measurement Information

English Units (°F)

F.P.	D.P.	F.P.	D.P.	F.P.	D.P.	F.P.	D.P.
+32	+32	+10	+ 7.4	-12	-16.7	-34	-40.3
+31	+30.8	+ 9	+ 6.3	-13	-17.8	-35	-41.4
+30	+29.7	+ 8	+ 5.2	-14	-18.9	-36	-42.4
+29	+28.6	+ 7	+ 4.1	-15	-20.0	-37	-43.5
+28	+27.5	+ 6	+ 2.9	-16	-21.1	-38	-44.5
+27	+26.4	+ 5	+ 1.8	-17	-22.2	-39	-45.6
+26	+25.2	+ 4	+ 0.7	-18	-23.3	-40	-46.6
+25	+24.1	+ 3	- 0.4	-19	-24.3	-41	-47.7
+24	+22.9	+ 2	- 1.5	-20	-25.4	-42	-48.7
+23	+21.8	+ 1	- 2.6	-21	-26.4	-43	-49.8
+22	+20.7	0	- 3.7	-22	-27.5	-44	-50.8
+21	+19.6	- 1	- 4.8	-23	-28.6	-45	-51.9
+20	+18.5	- 2	- 5.8	-24	-29.6	-46	-52.9
+19	+17.4	- 3	- 6.9	-25	-30.6	-47	-54.0
+18	+16.2	- 4	- 8.0	-26	-31.7	-48	-55.0
+17	+15.1	- 5	- 9.1	-27	-32.8	-49	-56.1
+16	+14.0	- 6	-10.2	-28	-33.9	-50	-57.1
+15	+12.9	- 7	-11.3	-29	-35.0	-51	-58.2
+14	+11.8	- 8	-12.4	-30	-36.1	-52	-59.2
+13	+10.7	- 9	-13.5	-31	-37.2	-53	-60.3
+12	+ 9.6	- 10	-14.6	-32	-38.2		
+11	+ 8.5	- 11	-15.6	-33	-39.3		

Reference: Smithsonian Meteorological Tables, Sixth Revised Edition, List, Robert J., Publication No. 4014, Smithsonian Institution, Washington, D.C.

7.1.8 Pressure Conversion

As the total pressure of a gas sample changes, all of the partial pressures comprising the total pressure change in the same ratio.

Example 1. (Metric Units)

If the frost point = -60°C and system total pressure is 1013 mb (1.033 kg/cm²), what is the dew point at 21 kg/cm²?

$$\frac{\text{Vapor Pressure at -60°C}}{1.033\ \text{kg/cm}^2} = \frac{\text{Vapor Pressure at New Dew Point}}{21\ \text{kg/cm}^2}$$

Vapor Pressure at New Dew Point =

10.80×10^{-3} mb x $\frac{21}{1.033}$ = 0.2195 mb, partial pressure

From the Vapor Pressure Tables (over ice), the Frost Point = -35.2°C

Example 2. (English Units)

If frost point = -70°F and system total pressure is 14.7 psia, what is the dew point at 70 psig (84.7 psia)?

$$\frac{\text{Vapor Pressure at -70°F}}{14.7\ \text{psia}} = \frac{\text{Vapor Pressure at New Dew Point}}{84.7\ \text{psia}}$$

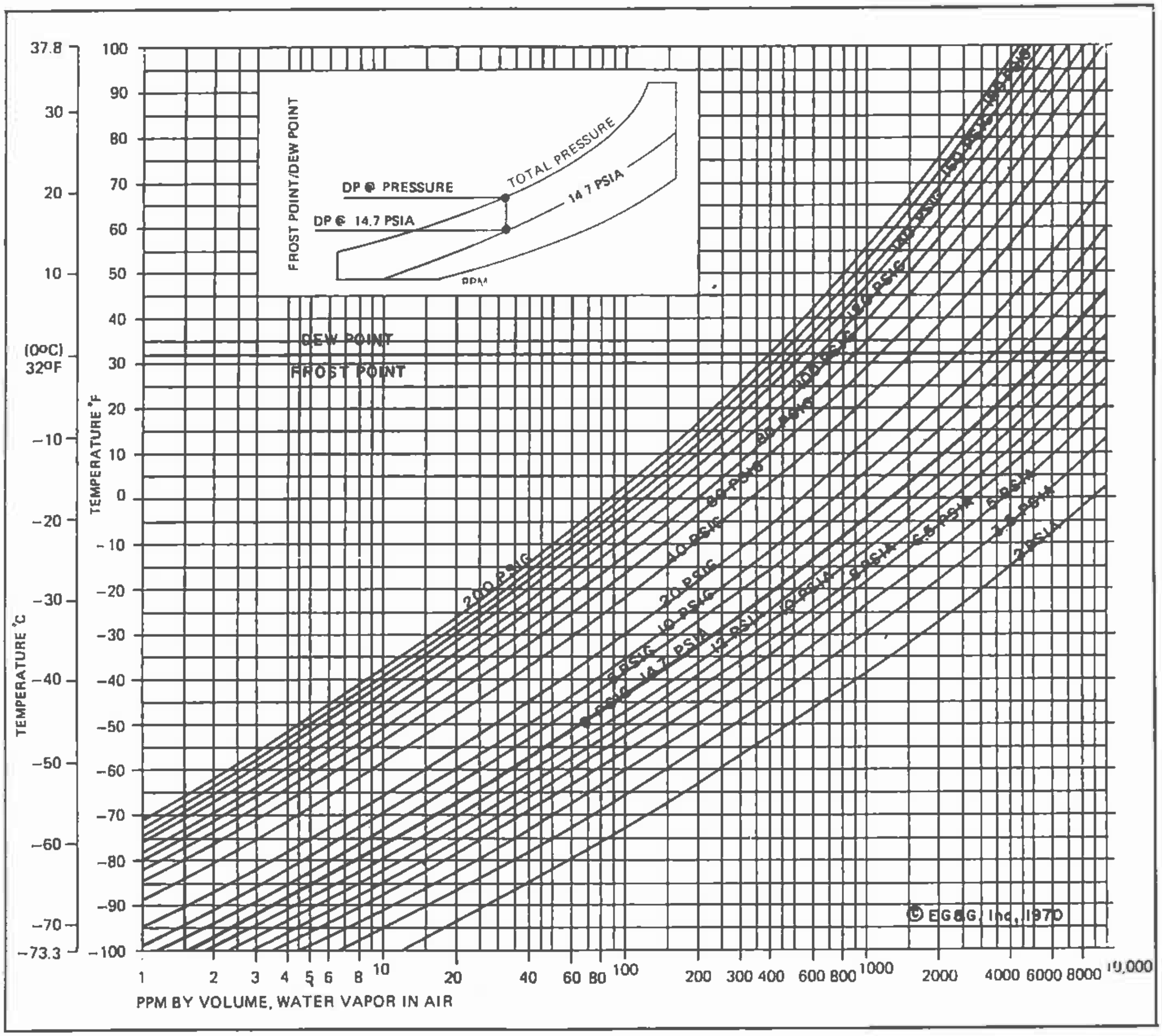
Vapor Pressure at New Dew Point = 4.974 x

10^{-4} in. Hg x $\frac{84.7}{14.7}$ = 2.87×10^{-3} in. Hg partial pressure

From the Vapor Pressure Tables (over ice), the Frost Point = -44.5°F

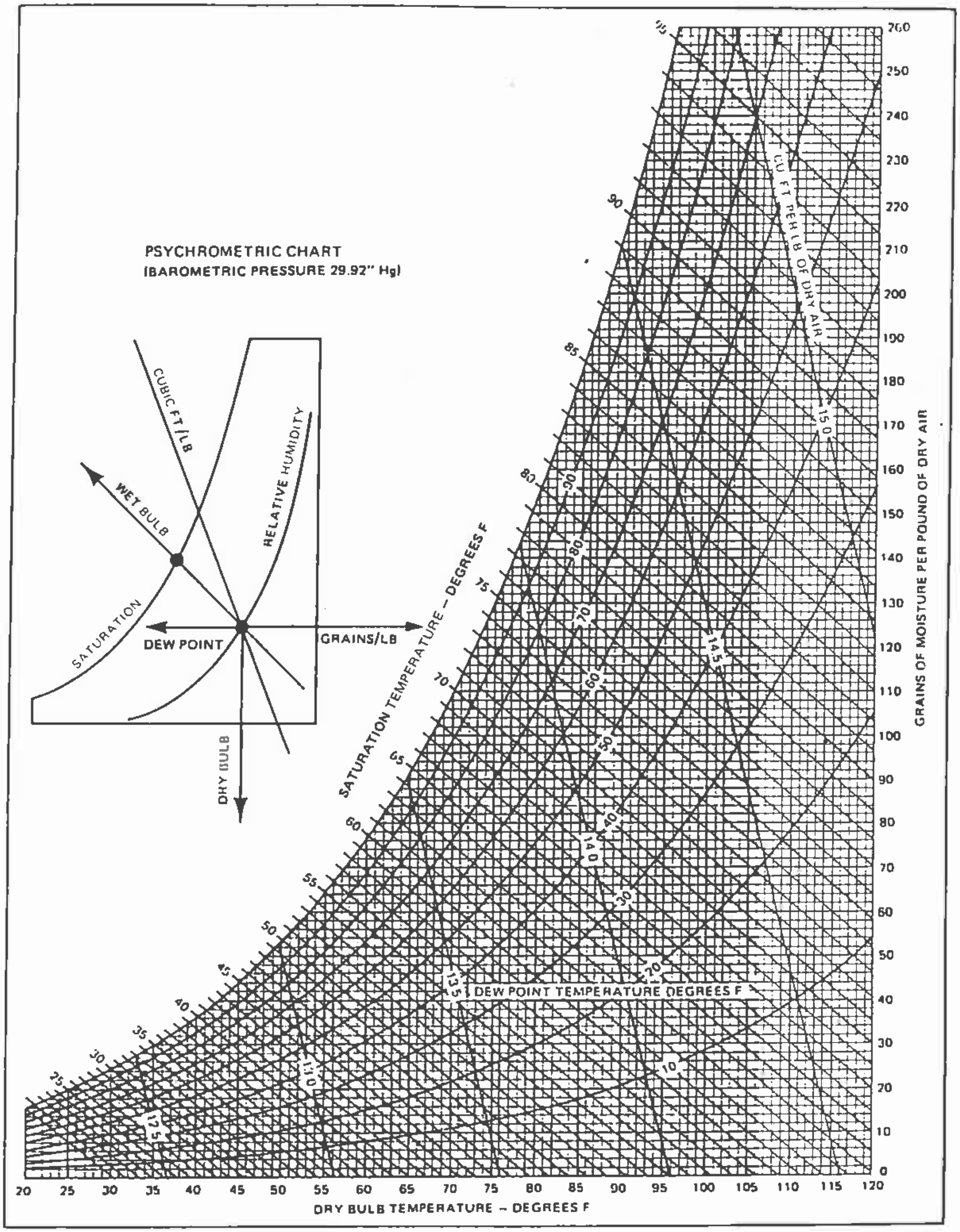
General Dew Point Measurement Information

7.1.9 Dew Point/Pressure Conversion Chart



General Dew Point Measurement Information

7.1.10 Psychrometric Chart



General Dew Point Measurement Information

7.1.11 Sample Flow Rate

When setting sample flow rates at other than 1 atmosphere (1.03 kg/cm² or 14.7 psia), or when gases other than air are involved, use Figures 7-1 and 7-2 to convert the indicated sample flow rate reading to the actual flow rate.

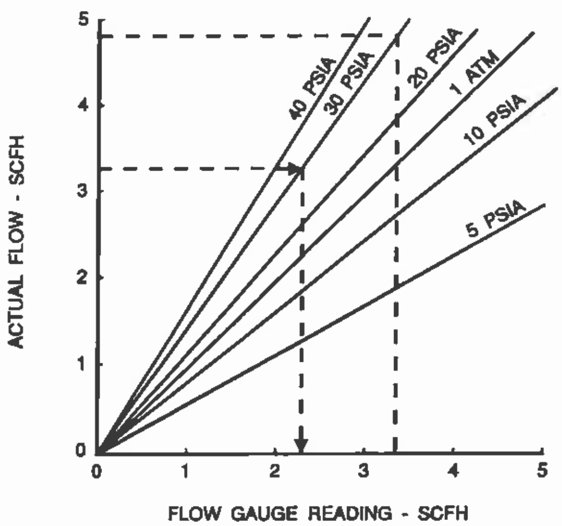


Figure 7-1. Flow Corrections for Various Flow Pressures.

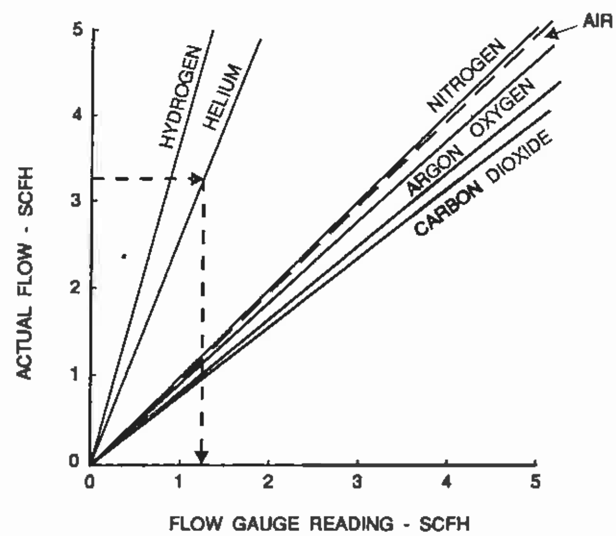


Figure 7-2. Flow Corrections for Various Gases.

7.2 RECOMMENDED HARDWARE

Flow Gauges (with valves)

Stainless Steel and Glass	Brooks Sho-Rate "50" No. 1350-V, or equivalent. Glass, range 0.2—4.5 SCFH
Brass and Lucite	Brooks-Mite No. 2001V, 0.10—4.5 SCFH

<u>Sample Tubing</u>	<u>Recommended Fittings</u>
Stainless Steel, 1/4 inch	Flare or Swagelok
Teflon (or Kel-F), 1/4 inch	Swagelok
Stabilized Polypropylene, 1/4 inch	Swagelok

Pumps

Carbon-Vane Type	Gast Mfg. Co. Model 0531-102B-347X (0.6 cfm), or equivalent
Diaphragm Type	Dynapump—Neptune Products Model 2 (2.25 cu in./min), or equivalent
Bellows Type	Metal Bellows Co. MB-21, or equivalent

Filters (General Purpose, In-Line)

Stainless Steel	NUPRO 4F-316, with 60-micron filter element, or equivalent
Brass	NUPRO 4F, with 60-micron filter element, or equivalent

General Dew Point Measurement Information

7.3 EG&G DEW POINT HYGROMETER SAMPLING SYSTEMS

7.3.1 General

Of all the factors considered in humidity measurement, one of the most important, and that which most often is given the least attention, is the sampling system. Considerations of leakage, pressure and temperature gradients, and moisture absorption/desorption characteristics are often overlooked.

The problem of leakage is relative; i.e., if the dew point being measured is close to the ambient room dew point, leakage into the system may not bias the reading substantially. If the system is pressurized above atmospheric so as to create a leakage out of, rather than into, the system, the error introduced will be less. The degree to which leakage can be tolerated also depends heavily on the actual dew point being measured. As an example, when measuring a dew point of -100°F with a sample flow rate of 4 SCFH, at an ambient or surrounding dew point of 50°F, a leakage in flow of 5 x 10^{-5} SCFH will cause an error of 1°F. However, at a measured dew point of +100°F, the same leakage rate would cause an error of only 0.00001°F. The area of leakage becomes significantly more important and the error becomes much larger in systems operating below ambient pressure.

7.3.1.1 Preheating

If the dew point of the gas under measurement is above the ambient temperature of the installation and the sampling lines, both the lines and the sensor must be heated with some type of heater tape, or the line must be steam-traced in the usual fashion. The approach used will vary widely with the specific nature of the installation, and the user must use his own ingenuity to ensure that none of the sampling components are at a temperature lower than the highest dew point anticipated. If electrical heater lines are used, it is desirable to connect these to a variable transformer to adjust the heating level. If the sample lines are long, it may be necessary to wrap them in insulating cloth to minimize the amount of heat required to do the preheating. The line should be heated well above the dew point and should not exceed the temperature rating of the sensor. A maximum of 200°F is usually recommended. Heating above the dew point does not change the dew point of the sample.

7.3.1.2 Selection Of Sampling Components

Of equal importance is the effect that material absorption/desorption characteristics have on overall system response. Although not true of all applications, stainless steel, glass, and nickel alloy tubing are the best possible nonhygroscopic materials and should be used for low dew point applications (0 to -100°F). Teflon is also satisfactory, but begins reducing system response due to desorption at the lower dew points. Copper and aluminum alloys, as well as stabilized polypropylene tubing, are acceptable above -20°F dew point. Most plastic and rubber tubing is unacceptable in all ranges. Unless attacked by the sample, the effect of the more hygroscopic materials is not of a contaminating nature, but actually one of introducing severe lag into the system during the establishment of an equilibrium condition. For example, plastics such as nylon cannot be used at low dew points simply because the equilibrium condition may actually take days to stabilize. The actual selection of the sample line material should be based on the degree of permanency of the installation, with a minimum of joints, fittings, and other plumbing prior to the hygrometer. Generally, stainless steel is preferred for permanent installations operating at low dew points. On stainless steel lines, either swage- or flare-type fittings can be used.

There are three types of pumps generally suitable for hygrometric work. For installations where the sample is not to be returned to the process, the Gast Manufacturing Co. vane pump is acceptable. This pump offers a reasonably high degree of reliability, and can handle large volumes of air. The vane type of pump does tend to contaminate the sample with minute amounts of pumpwear products (iron, carbon); therefore, it should be downstream of the hygrometer.

For general-purpose use or for closed-loop sampling at atmospheric pressure, any one of several types of diaphragm pumps, such as the Neptune Dynapump, can be used. The Dynapump uses a neoprene diaphragm, and the pump housing is aluminum.

For most closed-loop sampling where leak tightness is essential, welded bellows types such as the Metal Bellows MB-21 can be used.

7.3.2 Material Moisture Properties

All materials will absorb moisture to some extent. The curves shown in Figure 7-3 relate typical desorption properties of common sampling line materials after being exposed to a "wet" gas such as the ambient atmosphere. The curves illustrate the difficulty of obtaining a fast system response when switching from a high dew point sample to a low dew point sample. Even if the instrument responds instantly, the sampling lines dictate the overall response.

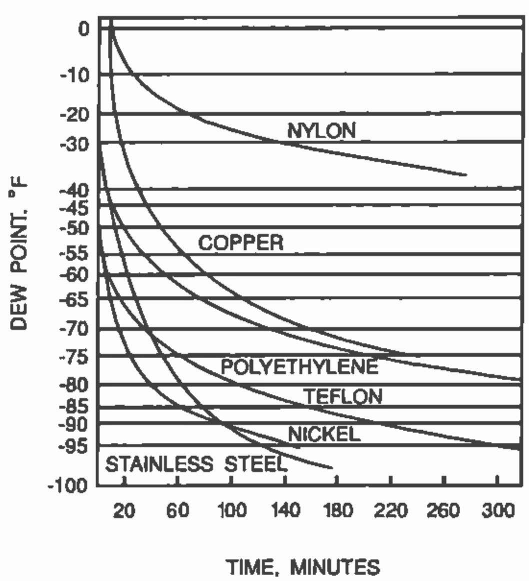


Figure 7-3. Desorption Properties of Common Sampling Line Materials.

7.3.3 Pressure Measurements

The dew point temperature of a gas is a measure of the absolute moisture content of the gas, regardless of the temperature and pressure of the gas. Most conversion tables for dew point (or frost point), to parts-per-million, grains-per-pound, etc., are made at atmospheric pressure (14.7 psia); therefore, if accurate absolute moisture content measurements are to be converted to atmospheric-pressure-referenced values, the pressure must be known. A pressure tap after the hygrometer sensor can be fitted with an appropriate pressure gauge. Basic Humidity Definitions are explained in subsection 7.1.

7.3.4 Cleaning Sampling Systems

Most types of metal tubing contain oil deposits on the interior walls due to the manufacturing process. This residue must be removed before putting the lines into service in a gas sampling system. Trichloroethylene or a similar solvent can be used to clean individual lines and components before assembly, with a final flushing after assembly. The lines should be purged dry with air or nitrogen before being placed into service. In addition to the initial installation, the process itself may constitute a source of contamination, and in many applications these are volatile hydrocarbons. An excellent fluid for purging and cleaning the instrument and/or the sample is Freon 114. This is a suitable solvent since it is capable of holding many hydrocarbons in solution, it is highly volatile, nontoxic, nonexplosive, readily available, and will not attack common sampling line materials. EG&G Dew Point Hygrometers are provided with Type A or Type B Cleaning Solution for use in cleaning and conditioning the sensor mirror. Type A is a general purpose cleaner for most applications. Type B is a special purpose cleaner recommended for heat treating, or similar applications, where oil vapors are present. This cleaner tends to make the sensor less sensitive to oil vapor condensation.

7.3.5 Contamination Effects

System contamination and its effect on dew point measurement can be subdivided into two categories—condensibles and noncondensibles. Before proceeding, it is important that one understands that the optical dew point analyzer measures the dew point, hence, the vapor pressure, of any substance that condenses on the mirror surface. Conversely, regardless of concentration, contamination constituents in a sample will not condense on the mirror unless its dew point temperature is reached.

General Dew Point Measurement Information

7.3.5.1 Condensibles

Condensibles can be further subdivided into soluble and insoluble condensibles. If insoluble, and its dew point is at or above that of the constituent being measured, the relative concentration level will mainly determine the effect on the measured dew point. If the concentration level of the contaminant is low, i.e., it has a low partial pressure compared to the water vapor, then the effect of its presence can be standardized periodically before it degrades the primary measurement. This is done by heating the mirror surface to remove the condensate and rebalancing the optical detection system. At high concentration levels, the dew point analyzer may measure the dew point of the contaminant rather than the water vapor dew point. This problem is lessened due to the high attenuation characteristics of dew or frost compared to many of the common contaminants. For example: if a water vapor dew point of 0°C was being measured at atmospheric pressure (760 mm Hg) and ethylene oxide was present as a contaminant at a concentration level of 10% (76 mm Hg), its dew point would be -35°C. Since this is below the water vapor dew point, it will not condense on the sensor mirror. However, this means that there would be interference if the water vapor dew point was below -35°C. If the contaminant is, in addition, soluble in the constituent being measured, it will modify the vapor pressure and, hence, the dew point of the sample. The overall effect will depend on the degree of solubility.

7.3.5.2 Noncondensibles

The second category of contaminants is the noncondensibles, which can again be subdivided into solubles, primarily salts, and insolubles, consisting of particulate matter. The soluble contaminant similarly will modify the partial pressure, or dew point, being measured. This type of contaminant affects all types of humidity instruments and necessitates frequent cleaning of the dew point mirror, since heating the mirror will not remove the salts. Insoluble matter is most easily avoided through sample line filtration.

7.3.6 Sampling Configurations

A suggested sampling system for use with EG&G Dew Point Hygrometers (Figure 7-4) would be one where a portion of the gas line to be sampled is brought to the hygrometer location from a pressure tap either by using a suitably designed vacuum pump, or by expanding the sample to a lower pressure. The flow rate through this main sampling line should be sufficient to ensure continuous flushing of the lines, in order to provide a fast response time for the sampling system. Usually, the flow rate of 2-4 SCFH in a 1/4-in. line is adequate; however, this number must be adjusted with the length of the line, the level of absolute moisture content of the sample, and the desired response time of the sampling system. A bypass line may be used to increase the main sampling line velocity and improve the overall response time. It is necessary that the sampling line be equipped with a valve for adjusting the sample flow rate. The sample for the hygrometer is obtained from the pressure drop across the bypass, as shown in Figure 7-2. It is desirable to provide the hygrometer input with a filter, especially if the gas under study contains particulate contaminants. Several suitable sintered stainless steel filters are available. The filter element is considered a hygroscopic item, which will contribute some lag to the sampling system. A rule-of-thumb in the design of hygrometer sampling systems is to minimize the number of components, such as valves, tees, and filters prior to the hygrometer input. The hygrometer output is connected to a flowmeter and valve for adjusting the flow rate to the recommended range of 2-4 SCFH.

NOTE

Considerable cost savings can be made by recognizing that the sample exhaust lines and related components need not be as high a quality and as nonhygroscopic as those *prior* to the hygrometer.

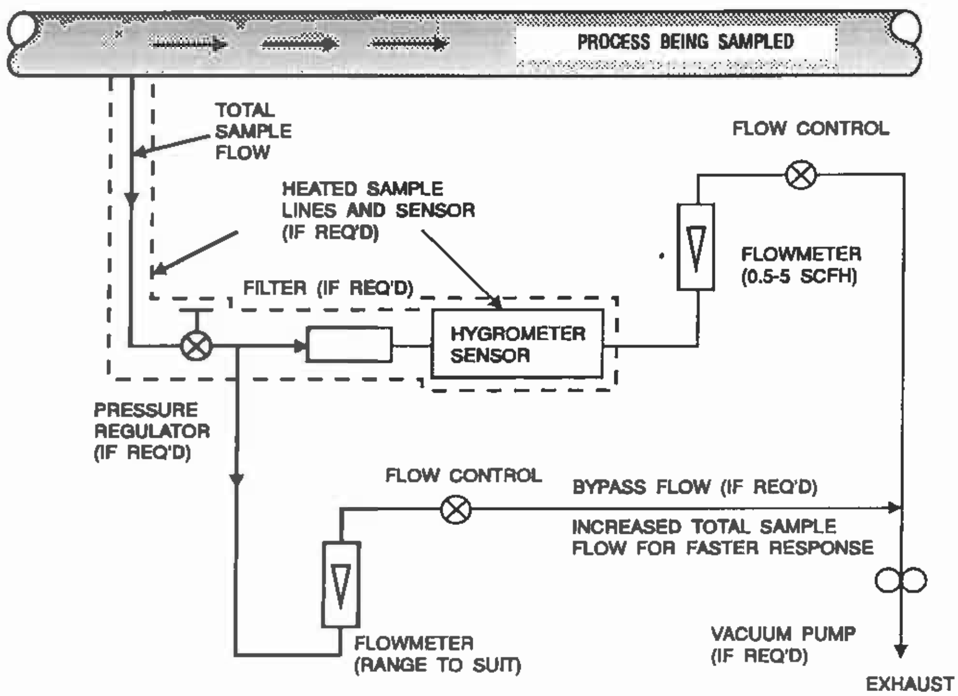


Figure 7-4. Sampling System Block Diagram.

Options/Spares Part Numbers

Part Number	Description
A24739	Model 300 Sensor, Complete Assembly
A24738	Model 300 Sensor, Optical Section
A24555	Model 300 Sensor, Lower Section
E24733	300 Mother Board Assembly
C24735	300 Switch Matrix Assembly
C24734	300-RD Readout Display Option
300-RH-C	300 Relative Humidity Computer, Degrees C
300-RH-F	300 Relative Humidity Computer, Degrees F
C25115	300 MPCBC Assembly
C24727	300 MUX/ADC Assembly
C25551	300 PRT AMP, Dew Point
A25553	300-AT Ambient Temperature Kit
C24737	300 Track and Hold
C25402	300 Sensor Buffer Assembly
C24365	300-CF C/F Display
300-BC	300-BC BCD Display
C27060-5	300-OC Output PPM Card
C27060-1	300-AS Alarm Set, 8 va at 0.25 amp
C27060-2	300-AS Alarm Set, 50 va at 1 amp
C27060-3	300-MA Current Output, 4-20 madc
C27060-4	300-MA Current Ouput, 4-20 madc, Isolated
300-DA-8VA	300-DA Dual Alarm, 8 va at 0.25 amp
300-DA-50VA	300-DA Dual Alarm, 50 va at 1 amp
A28835	300-PT Pressure Transducer Assembly
A24980	300-RC Remote Cable
A28383	300-TF In-Line Ambient Temperature Sensor Mount
A24981	300-RM Rack Mount Kit
A24982	300-PM Panel Mounting Kit
300-SS-115	Sample System Kit, 115 VAC
300-SS-220	Sample System Kit, 220 VAC
A25230	300-M Mirror Microscope
300-BF	300-BF In-Line Coalescing Filter
300-BX	300-BX Filter Element
300-FT	300-FT In-Line Sample Filter
300-DQ	300-DQ Filter Elements

Procedure for Returning Material

All Returned Material

It is necessary to obtain a Returned Material Authorization (RMA) number prior to returning any equipment to EG&G Moisture and Humidity Systems. This is to assist EG&G to recognize your equipment when it arrives at our Receiving dock, and to assist us in tracking your equipment while it is at our facility. The material should be shipped to the address indicated on the cover sheet of this manual.

Outside Continental United States

The following steps apply only to material being returned from outside the continental United States. These steps should be followed carefully to prevent delays and additional costs.

1. All shipments must be accompanied by two copies of your commercial invoice, showing the value of the material and the reason for its return. Whenever possible, please send copies of original export shipping documents with the consignment.
2. If the value of the equipment is over $1000, the following shipper's oath must be sent with the invoice. This oath can be typed on the invoice, or on a separate letterhead.

   "I, ______________________, declare that the articles herein specified are the growth, produce, or manufacture of the United States; that they were exported from the United States from the port of ______________________, on or about __________________; that they are returned without having been advanced in value or improved in condition by any process of manufacture or any other means; and that no drawback, bounty, or allowance has been paid or admitted hereof."

   Signed____________________________
3. If there is more than one part per consignment, a packing list must accompany the shipment. It is acceptable to combine the commercial invoice and packing list as long as the contents of each carton are clearly numbered and identified on the commercial invoice.
4. Consign all air freight shipments to EG&G Moisture and Humidity Systems in care of Intercontinental Transport Services, Inc., Logan International Airport, East Boston, MA 02128.
5. If the equipment is the property of EG&G Moisture and Humidity Systems, please insure for full value.
6. Route via Logan International Airport only as the final destination.
7. Mail one invoice, packing list, and copy of airway bill to EG&G Moisture and Humidity Systems upon shipment.
8. Please refer to the issued RMA number on all documents and correspondence.
9. Air freight must be paid on all returns.

IMPORTANT

When requesting information about this instrument, always furnish the serial numbers of the Control Unit and the Sensor. The Control Unit serial number is marked on the tag in the upper left-hand corner of the rear panel. The Sensor serial number is stamped into the metal on the top surface of the Sensor housing.