

THUNDER SCIENTIFIC CORPORATION

MODEL 5A-1MP
ELECTRONIC PSYCHROMETER
RELATIVE HUMIDITY AND TEMPERATURE
MEASUREMENT SYSTEM



OPERATION AND
MAINTENANCE MANUAL

THUNDER SCIENTIFIC CORPORATION
623 WYOMING BLVD. S.E.
ALBUQUERQUE, NEW MEXICO 87123-3198

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5A-1MP Laboratory Reference Psychrometer

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WARRANTY

Thunder Scientific Corporation warrants each instrument of its manufacture to be free from defect in materials and workmanship.

The limit of liability under this warranty is to repair or replace any part thereof which shall within one year after delivery to the original purchaser, and returned by the original purchaser, prove to be defective after examination by Thunder Scientific Corporation.

This warranty specifically excludes the probe sensors, which may become damaged or broken due to wick changes. Shipping damage is covered by insurance and will be honored if report is made within one week of receipt of the instrument. Warranty returns must be authorized by the factory.

GENERAL INFORMATION

1.1 GENERAL DESCRIPTION

The Thunder Scientific Model 5A-1MP is a microprocessor based Laboratory Standard Psychrometer designed for precise measurement of air temperature and relative humidity.

The 5A-1MP uses a 2-bulb measurement system employing Wet and Dry calibrated Platinum Resistance Thermometers (PRT's) operating under a controlled air velocity. One PRT, referred to as the Dry Bulb, is used for sensing air temperature. The other PRT, the Wet Bulb, uses a specially woven wick (or sock) to facilitate an unimpeded capillary flow of distilled or high purity reagent water from a reservoir below. The Wet Bulb measures a depression temperature.

The signals from the PRT's are converted to digital format, read by the microprocessor, and mathematically corrected to temperature data. The data is then used to calculate Percent Relative Humidity and Dewpoint Temperature.

Front panel display of any of the above data is selected by user input at the keyboard. The upper display is the data readout device, and the lower display indicates which data or other function is currently enabled. Upon selection of data output to this real-time LED display, current readings are updated four to five times each second allowing for fast system response to any changes in the sampled environment.

Printer output, enabled from the keyboard, allows for hardcopy printouts of all current psychrometric data. Printer output is at user selected time intervals ranging from a one minute minimum to 24 hour maximum, or at any one minute increment in between.

An Auto Mode feature is also included which, when enabled, will put the probe in synchronous operation with the printer. In this mode, the probe aspirator will automatically run prior to any sample for hardcopy output. After printout, the aspirator will be disabled and will remain off until the next sample time is reached.

Bi-directional RS-232 and optional IEEE 488 communication capabilities allow for remote operation and data retrieval when connected to a computer or terminal. All functions available from the front panel keypad are also available over the RS-232 and IEEE 488 links through a series of more than 40 commands.

The Model 5A-1MP is a precision laboratory grade instrument, and when operated and handled accordingly, will provide years of excellent service.

1.2 SPECIFICATIONS

Relative Humidity (RH)

Measurement Range	1% to 100% RH
Resolution	0.01% RH
Guaranteed Accuracy	±1% RH
Typical Accuracy	±0.5% RH

Temperature

Measurement Range	0-100°C / 32-212°F
Resolution	0.01°C and °F
Guaranteed Accuracy	±0.3°C / ±0.5°F
Typical Accuracy	±0.1°C / ±0.2°F

Data Interface

Printer Interface	Centronics Parallel
Computer Interface (standard).....	Bi-directional RS-232
Computer Interface (optional)	IEEE 488

<u>Power Requirements</u>	115 VAC, 50/60 Hz (OPT) 220 VAC, 50/60 Hz
---------------------------------	--

1.3 FEATURES

- 1) Z-80 Central Processing Unit, automatically computes percent relative humidity, temperature, and dewpoint in °C or °F.
- 2) Bi-directional RS-232 and IEEE 488 computer interfaces allow for remote operation/data collection.
- 3) Battery backed-up real time clock.
- 4) Centronics printer interface with user selectable input intervals from one minute to 24 hours in one minute increments.
- 5) AUTO mode capability enables probe aspirator for one minute prior to each printout.
- 6) Non susceptible to contamination by chemicals or long term exposure to high relative humidity and temperature.
- 7) Certification of Traceability to the National Institute of Standards and Technology.
- 8) Direct NIST certification available.

INSTALLATION

2.1 GENERAL

The 5A-1MP is designed as a portable test instrument requiring no special physical installation. The instrument must, however, be connected to a source of AC power (Section 2.2) and may be connected to a printer and/or computer (Sections 2.2, 2.3, 2.4) for remote data collection and coefficient manipulation (also see Figures 2-1, 2-2, and 2-3).

2.2 ELECTRICAL

Using the 6' power cord provided, connect the 5A-1MP to a 115 VAC, 50/60 Hz, grounded outlet.

2.3 COMPUTER/PRINTER INTERFACING

The RS-232 computer interface shares a connector with the parallel printer interface (refer to Section 8.2 for the specific pinouts). Since the computer and printer interfaces are sharing the same connector, only the cables supplied by the factory should be used. When replacing or repairing factory supplies cables, the wiring connections described in Section 8.1 must be followed.

If a computer is to be connected via the RS-232 interface (but no printer is to be connected), use the small round interface cable with the hooded DB25 connectors at each end. Plug the cable end marked "5A-1MP" into the DB25 connector on the psychrometer. Plug the other end into an RS-232 port of a computer or terminal. Depending upon the connections at the computer terminal, a gender changer, null modem adapter, or other interface cables/connectors may be required.

Communicating with the 5A-1MP via the RS-232 interface is discussed in Section 5.

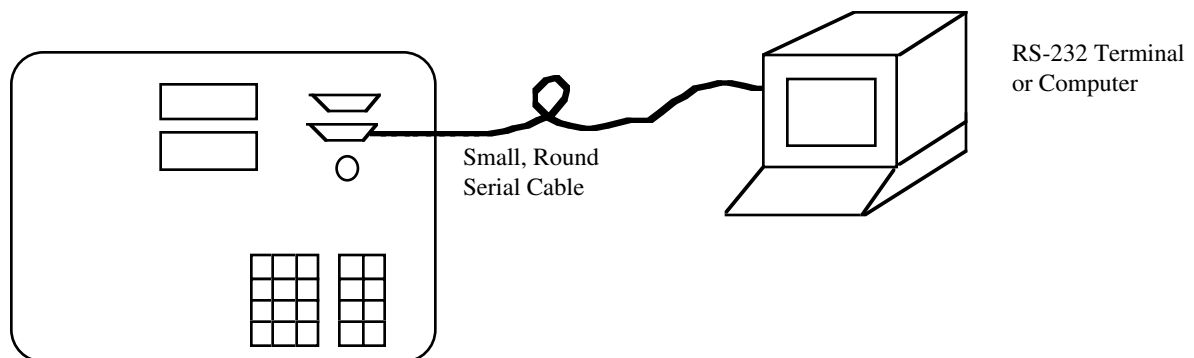


Figure 2-1
Computer/Terminal Connection

If a printer is to be connected, use the flat ribbon type cable which contains a Centronics type 36 pin ribbon-D connector on one end, and two DB25 connectors on the other end. Plug the 36 pin Centronics connector into the mating connector of the printer. Plug one of the DB25 connectors into the mating connector of the psychrometer. Note that only one of the DB25 connectors is of the proper gender to mate with the psychrometer.

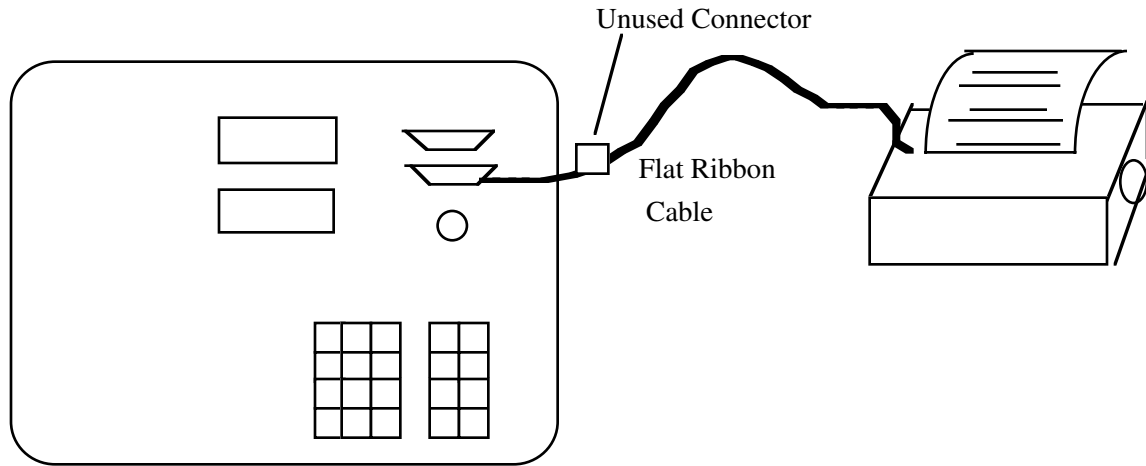


Figure 2-2
Printer Connection

If both the printer and computer are to be connected to the psychrometer, connect the printer first by following the procedures previously outlined (see Figure 2-2). Then plug the RS-232 cable into the unused connector on the printer cable. This connection scheme allows both the printer and computer to communicate with the 5A-1MP simultaneously.

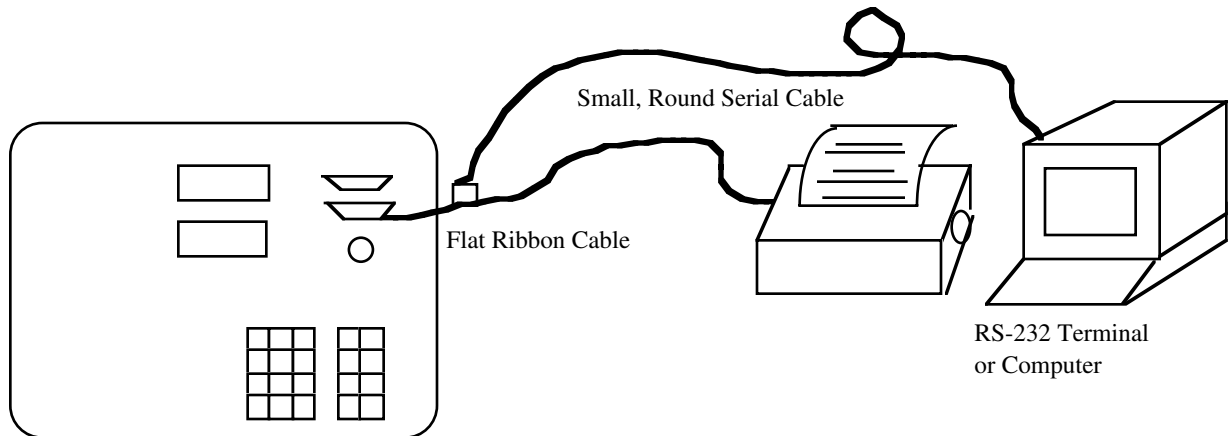


Figure 2-3
Computer/Terminal and Printer Connections

2.4 IEEE 488 INTERFACING (OPTIONAL)

The 5A-1MP may be connected to an IEEE 488 bus via its 24 pin D-type IEEE 488 connector located on the top panel above the computer/printer interface connector (see Figure 2-4). IEEE 488 communication with the 5A-1MP is discussed in Section 8. See Section 8.1 for wiring specifications.

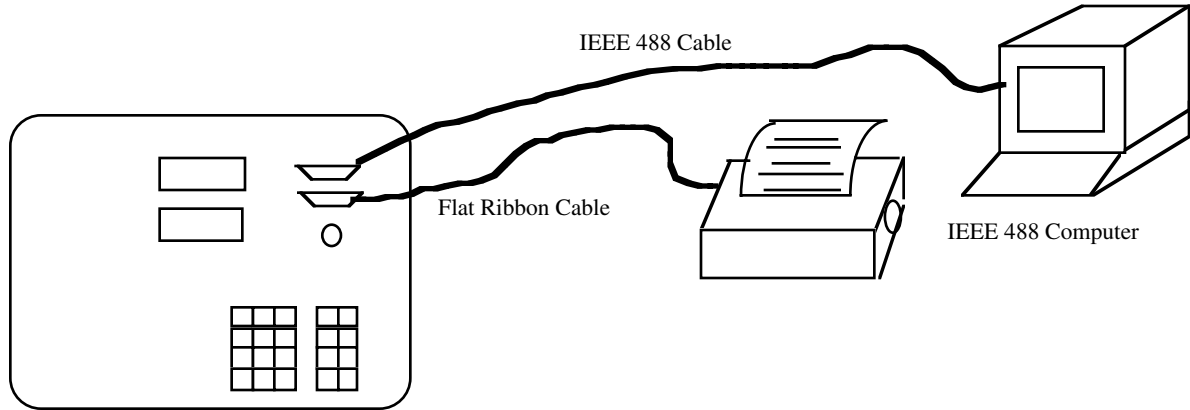


Figure 2-4
IEEE 488 Connection

OPERATION

3.1 GENERAL

The 5A-1MP is capable of operation in either manual or automatic mode, invoked either from the keypad, the serial interface, or the IEEE 488 interface. In general, operation consists of filling the probe reservoir with pure distilled water, turning the 5A-1MP ON, entering the current barometric pressure, and enabling the blower (or aspirator) motor. After taking data, the blower motor should then be turned off until another sample is required.

3.2 STANDARD OPERATING PROCEDURES

3.2.1 Power-up

Ensure that installation is performed in accordance with Section 2. Press the power switch ON. The LED Displays should indicate the time of day on the upper panel, and P--7 (meaning parameter 7, the time) on the lower panel. If for some reason the power-up mode appears incorrect, either cycle the power off and on again or execute a cold reset. A cold reset is executed by pressing the reset key while holding down the decimal point key. This procedure performs exactly the same function as cycling the power off and on. All values, functions, and modes of the system are restored to their power-up default status.

NOTE 1: Due to the use of CMOS circuitry within the 5A-1MP, peripherals such as a printer may be supplying enough power to the 5A-1MP to prevent it from fully cycling down during a power-off sequence. This failure to fully cycle down may cause an invalid power-up sequence. To prevent this problem, one or both of the following should be performed when peripheral devices are connected to the 5A-1MP:

- A) Power down peripherals when powering down the 5A-1MP. When powering up, power up the 5A-1MP first, then power up the peripherals.
- B) Hold down the decimal point key on the keypad while either powering up or pressing RESET. This forces the 5A-1MP through the proper power up initialization sequence regardless of any previous failure to fully cycle down.

3.2.2 Probe Preparation

The black probe housing contains two Platinum Resistance Thermometers (PRT's) which are used for measuring the air temperature (called the Dry Bulb temperature) and the depression temperature (called the Wet Bulb temperature). The Wet Bulb sensor is the one which is covered by the woven cotton wick. During operation, the wick remains wet by drawing water (through capillary action) from the reservoir in the bottom of the probe housing. The reservoir must be filled prior to operation, and drained after operation allowing the wick to dry. (The probe should never be stored with a wet wick, as a stagnant wet wick provides an excellent media for the growth of micro-organisms (bacteria), thus altering the accuracy of the instrument).

Fill the reservoir with pure distilled water by removing the filler plug (the larger of the two screws) on the bottom plate of the probe housing. A dime usually works well for this purpose. Using the bottle and dropper provided, fill the reservoir to the bottom of the filling hole, while holding the probe so that the round white teflon shaft is vertical, and the motor end is downward. Replace the filler plug and tighten. Squirt several droppers full of water directly on the wick covering the Wet Bulb sensor. This flooding procedure is used to clean the wick and flush away possible contaminants. Dry the probe by gently shaking out excess water from within the teflon shaft portion of the probe. Avoid tapping or banging the probe. Cotton swab sticks (Q-tips) may be needed to thoroughly dry the inside of the white teflon probe shaft. Also dry the outside with a clean cloth while watching for leaks around the bottom of the probe at the edges of the reservoir cover. The reservoir cover is sealed by a rubber gasket and secured by the small screw in the center. Tighten this center screw as necessary.

Place the probe in the environment to be tested and connect the white power signal cable. If multiple probes were calibrated with this 5A-1MP, ensure that the probe number and cable number match, as they were calibrated from the factory as a set. Connect the other end of the cable to the mating connector on the 5A-1MP.

3.2.3 System Operation

In order to measure relative humidity and other psychrometric data in the test environment, the user must

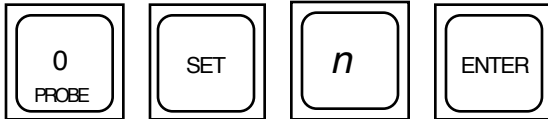
- 1) Prepare the probe. (Refer to Section 3.2.2).
- 2) Enter the probe number. (Refer to Section 3.2.4).
- 3) Enter the current pressure. (Refer to Section 3.2.5).
- 4) Aspirate the probe. (Refer to Section 3.2.7).
- 5) Wait approximately 1 minute for stabilization.
- 6) Display and/or print data. (Refer to Sections 3.2.8,).
- 7) Stop probe aspiration. (Refer to Section 3.2.7).

If the psychrometer is being operated within a humidity generator (such as the Thunder Scientific Model 8500 Automated Two-Pressure Humidity Generator), fittings are available in order to aspirate the probe from the humidity generator rather than the blower motor. When using external sources such as this for aspiration, the flow rate of the source must be known and entered into the 5A-1MP. (Refer to Section 3.2.6, Entering the Flow Rate).

3.2.4 Probe # Selection

If the 5A-1MP has been supplied with more than one probe, the probe number which is currently connected to the system must be entered so that the appropriate calibration coefficients will be used in all mathematical calculations of Dry Bulb and Wet Bulb temperature. Failing to enter the probe number of the currently connected probe will result in erroneous data. Greatest accuracy will also be achieved when using a numbered probe cable which matches the number on the probe, since the probe and cable are factory calibrated as a set.

Enter the probe number by pressing



where n is a number between 1 and 4 corresponding to the number on the connected cable and probe. The power-up default is always Probe 1. The probe number may also be changed from either the IEEE 488 or the RS-232 interface. (Refer to **PROBE** command, Section 7).

3.2.5 Entering the Pressure

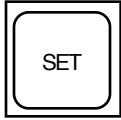
For proper RH calculations, the absolute pressure of the test environment must be known and entered (in inches of mercury) into the 5A-1MP. The actual pressure may be measured using an absolute pressure transducer available from a number of different manufacturers. An alternate method is to obtain the approximate barometric pressure from the nearest airport or weather station. Be sure to obtain the actual pressure before any altitude adjustments have been applied. Since the pressure must be entered into the 5A-1MP in inches of mercury, some common conversions follow.

$$\begin{aligned} \text{in Hg} &= \text{PSIA} * 2.03602 \\ &= \text{Pa} * 0.00014503774 \\ &= \text{kPa} * 0.14503774 \\ &= \text{atm} * 29.921 \\ &= \text{mm Hg}/25.4 \\ &= \text{in H}_2\text{O}/13.6086 \\ &= \text{mm H}_2\text{O} * 1.8665 \\ &= \text{Torr}/25.4 \\ &= \text{Bar} * 29.53 \\ &= \text{mb}/33.8638 \end{aligned}$$

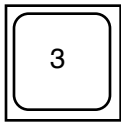
Convert the pressure to inches of mercury if required and enter it in the following manner; however, use the appropriate pressure. For example, to enter a pressure of 30.12 inches of mercury, press



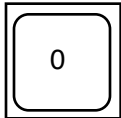
LED's display RH on top, P--1 on bottom.



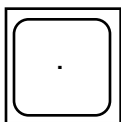
Enables SET mode. Displays Pressure setting (factory default 29.92)
(Note Press. and Set are same color).



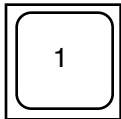
30.12 Displays 9.923



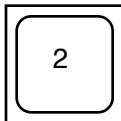
30.12. Displays 9230



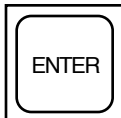
30.12. Displays 9230.



30.12. Displays 230.1



30.12. Displays 30.12

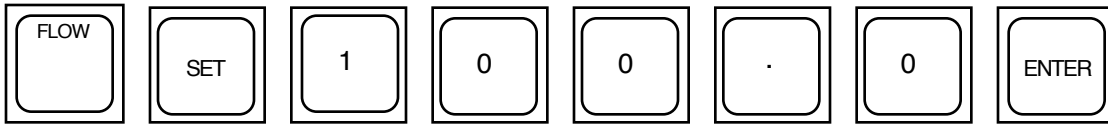


Ends SET mode. Display reverts to previous reading.

This new pressure value only remains valid until changed again from the keypad, serial interface or IEEE 488 interface, or until the unit is cold reset as in Section 3.2.1. Note that the decimal point is required but that it will automatically trail the second digit entered unless the decimal point key is pressed during the entry sequence. To change the pressure from either the RS-232 or IEEE 488 interface, refer to the **PRES**sure command, Section 7. To save the currently entered pressure as the power up default pressure, use the **SAVE** command, Section 7.

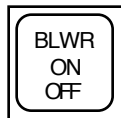
3.2.6 Entering the Flow Rate

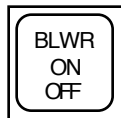
When aspirating the probe from an external source such as an 8500 Automated Two-Pressure Relative Humidity Generator, the system mass flow rate may be entered into the psychrometer. As an example, a mass flow rate of 100 SLPM would be entered by pressing



This number only remains valid until changed again from either the keypad, the IEEE 488, or the serial interface, or a cold reset is performed. (Refer to Section 3.2.1, Power-Up). Also, anytime the unit is aspirated by enabling the internal blower motor, the flow rate entered is ignored and all calculations are performed utilizing a preset flow rate determined during factory calibration. If probe aspiration is always accomplished with the internal blower, the flow rate need not be altered from its power-up default value. The flow rate may also be set from either the RS-232 or IEEE 488 interface. (Refer to **FLOW** command, Section 7).

3.2.7 Enabling/Disabling the Blower

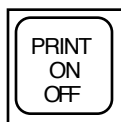


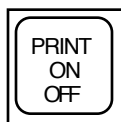
Pressing the  key enables and disables the blower motor within the probe. When enabled, the leftmost dot of the lower LED display will illuminate. The blower should be enabled for at least 30 seconds to 1 minute prior to taking readings in order to allow the system to stabilize. After the desired readings have been taken, disable the blower by pressing the same key again. The blower may also be controlled from either the RS-232 or IEEE 488 interface. (Refer to **BLOW**er command, Section 7). Note that there is a normal 1 to 2 second delay associated with blower turnoff.

3.2.8 Enabling/Disabling the Printer


If a printer is connected to the psychrometer. (Refer to Section 2.3, Computer/Printer Interfacing), current printouts of all relevant psychrometric data is available.

To enable the printer,



press the  key on the keypad. The second dot from the left on the lower display will illuminate, and data will then be printed at the specified time intervals. (Refer to Section 3.2.12, Changing the Time Interval). Pressing the key again disables the printer.








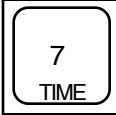




The  key may be used at any time to immediately send one line of data to the printer.

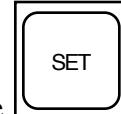
The start of each page is preceded with a header and the end of each page is appended with a formfeed (or top of form), provided that headers and formfeeds are enabled. (Refer to Section 3.2.13, Printer Options). The printer may also be controlled from either the RS-232 or IEEE 488 interface. (Refer to **PRIN**ter command, Section 7).

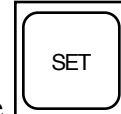
3.2.9 Displaying Desired Readings

With the 5A-1MP in the normal parameter display mode, indicated by a "P" on the leftmost digit of the lower LED display, select the desired display parameter by pressing any of the numeric keys. The keys and associated parameters are listed below:

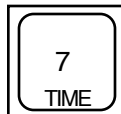
<u>Key</u>	<u>Display Parameter</u>
	Probe #
	RH
	Dewpoint
	Dry Bulb Temperature
	Wet Bulb Temperature
	Dry Bulb Resistance
	Wet Bulb Resistance
	Time of Day
	Date
	Time Interval between printouts

Notice that the display parameters relate to the black text on the bottom of the keys.

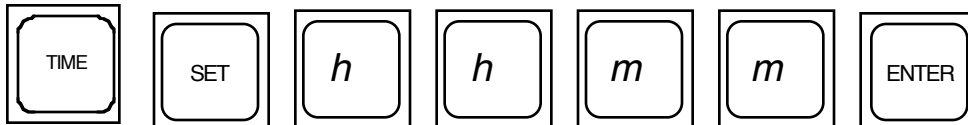


The blue text at the top of some of the keys indicates that when using the  key, it is the parameter in blue which will be changed. (Refer to Sections 3.2.4-3.2.6, 3.2.10-3.2.14 for use of the SET key). Those keys without blue text have identical SET and DISPLAY parameters. (Exceptions are the Dry Ω and Wet Ω which have no corresponding SET parameters).

3.2.10 Changing the Time




Display the time by pressing the  key on the keypad. To change the time, press



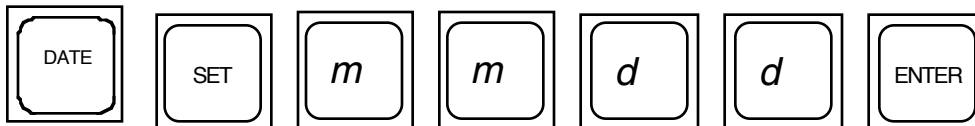
where *hh* and *mm* are the hours and minutes desired. Time is entered in 24 hour military format. For example, the time 6:15 p.m. must be entered as 1815. The time may also be set from either the RS-232 or IEEE 488 interface. (Refer to **TIME** command, Section 7).

3.2.11 Changing the Date



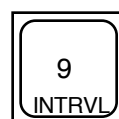
Display the date by pressing the  key on the keypad.

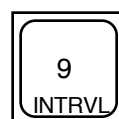
Change the date by pressing



where *mm* and *dd* are the month and day respectively. For example, December 25 is entered as 1225. The date may also be set from either the RS-232 or IEEE 488 interface. (Refer to **DATE** command, Section 7).

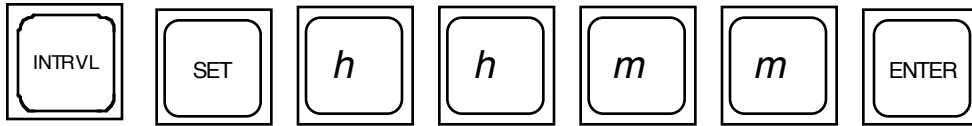
3.2.12 Changing the Time Interval



Display the printout time interval by pressing the  key on the keypad. The numbers shown on the upper display represent the hours and minutes between printed

readings whenever the printer is enabled (note that the printer is automatically enabled in AUTO mode).

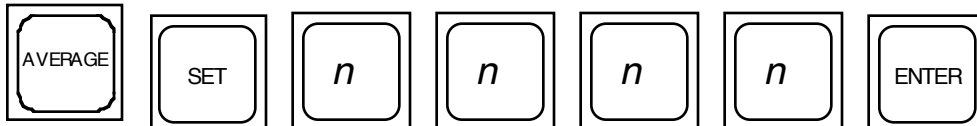
To change the interval from its 1 minute default, press



where *hh* and *mm* represent the desired hours and minutes between printouts. Allowable intervals range from a minimum of 0001 (1 minute) to a maximum of 2359 (23 hours, 59 minutes). The interval may also be set from either the RS-232 or IEEE 488 interface. (Refer to **INTE**rval command, Section 7).

3.2.13 Changing the Amount of Averaging

On power-up, the averaging amount is set to 0 and no internal averaging takes place. While averaging is not normally required for stable readings, its use may prove beneficial in unstable and/or electrically noisy environments. The 5A-1MP uses a weighted sum averaging technique where by the currently displayed value is multiplied by *n*, added to the new value, then the total is divided by *n* + 1. To change the averaging from its 0 default value, press



where *nnnn* is a number between 0000 and 9999 inclusive, with reasonable values between 0 and 100.0 inclusive. Note that fractional numbers are also valid. The averaging amount remains valid until changed, or until a cold reset is performed. (Refer to Section 3.2.1, Power-Up). Averaging may also be changed from either the RS-232 or IEEE 488 interface. (Refer to **AVER**age command, Section 7).

3.2.14 Changing the Printer Options

Printer options available from the keypad include

- A) Enabling/disabling formfeeds.
- B) Enabling/disabling the header.
- C) Setting the end of line terminator to
 - 1) Carriage return only.
 - 2) Line feed only.
 - 3) Carriage return, line feed.
 - 4) Line feed, carriage return.
- D) Setting the number of lines per page.

The factory default printer options are set at and broken down as follows:

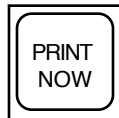
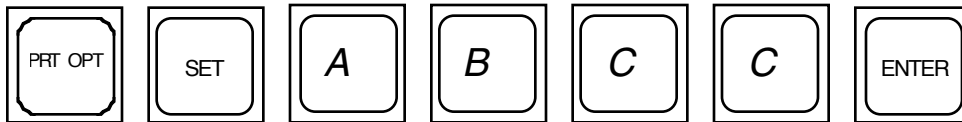
0 3 6 0
A B C C

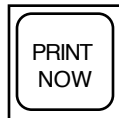
A = 0 for a carriage return only at the end of each line (factory default).
1 for a line feed only.
2 for a carriage return then line feed.
3 for a line feed then carriage return.

B = 0 for no header and no formfeeds.
1 for header, but no formfeeds.
2 for formfeeds, but no header.
3 for header and formfeeds (factory default).

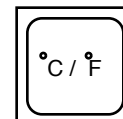
CC = 00-99 lines per page. (factory default=60).

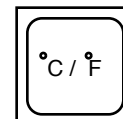
To change the printer options, first determine the appropriate 4 digit number **ABCC** from the previous descriptions, then enter the number by pressing



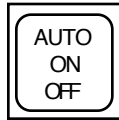
If the printer was enabled, or if the  key had been used prior to setting the printer options, the printer may need to be disabled then re-enabled to make the new printer options become valid (primarily when changing the lines per page). The options entered remain valid until changed again or a cold reset is performed. (Refer to Section 3.2.1, Power-Up). Printer options may also be set from either the RS-232 or IEEE 488 interface. (Refer to **FORM**feed, **HEAD**er, **ENDL**ine, and **LINE**s commands, Section 7). Current printer options may also be stored as power-up defaults through the use of the **SAVE** command, Section 7.

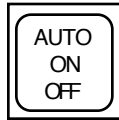
3.2.15 Switching Between °C and °F



The 5A-1MP powers up in °F mode. To switch to °C, press the  key. The rightmost dot on the lower LED display will illuminate. Return to °F with the same key. This key affects the display and printer temperature scales only, and does not affect the temperature scale of the serial and IEEE 488 interfaces which are always °C. The temperature scale is also selectable through either the RS-232 or IEEE 488 interface. (Refer to **DEGR**ees command, Section 7).

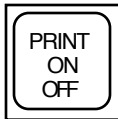
3.2.16 Enabling the AUTO mode

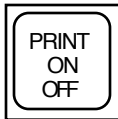


Enable the AUTO mode by pressing the  key. The third dot from the left on the lower display will illuminate indicating the AUTO mode is now enabled. The AUTO mode also enables the printer (illuminates the second dot) and controls the operation of the blower motor (the first dot). In AUTO mode operation, the 5A-1MP will automatically enable the blower exactly 60 seconds prior to each printout of data which occurs at the specified time interval. (Refer to Section 3.2.12, Changing the Time Interval). The blower will then be disabled immediately following each print, and will remain off until 60 seconds prior to the next print time. In this way, the blower remains on for only 1 minute during each sampling time interval, greatly extending the service of the blower motor which has a 300 hour nominal run life. Note that if the interval is set to 1 minute, the blower will remain on continuously.

NOTES:


- 1) While in AUTO mode, the printer remains enabled and cannot be disabled by the user.

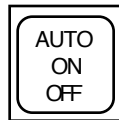


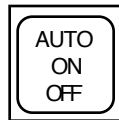
The  key is therefore locked out and has no effect.

- 2) Once within the 60 seconds prior to each print time when the blower is enabled, it may not be disabled by the user.



The  key is therefore locked out and has no effect during this 60 second time interval.



The AUTO mode is disabled by pressing the  key again. Disabling AUTO mode also disables the printer and blower motor, restoring them back to user control from the keypad. The AUTO mode may also be controlled from either the RS-232 or IEEE 488 interface. (Refer to **AUTO** command, Section 7).

MAINTENANCE

4.1 PROBE WICK CHANGEOUT INSTRUCTIONS

The CK-1 Wick Changeout Kit is provided to easily change wicks in the sensing probe. Wick changes should be performed after approximately 40 hours of operation, or more often, particularly if the instrument is in a dirty environment. A replacement wick supply should be kept on hand and can be ordered from the factory in advance of the need. Consult the factory for current price information in the event a replacement supply is needed.

To change the wick, perform the following:

- 1) Place probe upside down upon two blocks of wood or other material, one on each side of the probe handle.
- 2) Remove reservoir plug, cover screw, and rubber feet.
- 3) Gently pry reservoir cover with plastic tool and remove.
- 4) Carefully remove the four housing retainer screws located in the corners of the probe; they join the two halves of the probe.
- 5) Gently remove bottom half of probe housing, feeding the wick through the vertical teflon wick tube. Keep the large horizontal teflon air sleeve in place during removal.

Note - Blower motor is also loose once housing is removed.

- 6) Lift teflon air sleeve up and off the sensor mounts taking care to feed the wick through the air sleeve avoiding any lateral movement and undue strain upon the sensor.
- 7) The sensor and wick are now in the open where the wick may be removed. Using the dropper provided, apply several drops of ethyl alcohol to the portion of the wick covering the sensor. Allow to soak for approximately one minute, replenishing the alcohol as evaporation occurs.
- 8) Using one of the picks provided, gently probe the wick covering the sensor to loosen.
- 9) Using the curved tweezers provided, very gently push the wick up on itself or up on the sensor, assisting with the other hand from the reservoir side. (The wick construction is very similar to a "Chinese finger puzzle" in that pushing tends to release it where pulling only tightens the wick and compounds the problem of removal.) The wick should expand. When this occurs, use the tweezers to slide the wick from the sensor.

CAUTION!

IF WICK IS FROZEN TO THE SENSOR WITH DEPOSITS DUE TO CONTAMINATED WATER, DO NOT FORCE. THIS WILL BREAK THE SENSOR LEADS, CAUSING EXPENSIVE REPAIR COSTS. IF ALCOHOL DOES NOT LOOSEN THE DEPOSIT, RETURN TO THUNDER SCIENTIFIC FOR REMOVAL. THUNDER SCIENTIFIC IS NOT RESPONSIBLE FOR LEAD BREAKAGE AND/OR SENSOR REPLACEMENT IF SUCH OCCURS.

If a wick changeout schedule is maintained and the water is drained from the probe after each use this problem should not occur.

- 10) Apply provided finger cots to the thumb and index finger of each hand. Soak a clean cloth with alcohol and remove all traces of talcum from the outer surfaces. If this is not done, the wick becomes contaminated.
- 11) The replacement wicks are supplied in a sealed vial of alcohol. Remove wick from the vial.
- 12) Using the taper tool provided, push the wick onto the tool approximately one inch or more, causing expansion by pushing on the wick.
- 13) Remove from tool and clip frayed end square.
- 14) Slide wick gently onto sensor and over the teflon to the shoulder.
- 15) Using the dropper, apply several drops of water on the wick at the sensor. Note wick expands slightly, indicating water retention. Gently form the wick around end of sensor and flatten between the sensor and wick tube to offer minimum wind resistance.
- 16) Feed wick through teflon air sleeve, slide sleeve over teflon sensor mounts, and seat it on the probe half.
- 17) Feed wick through wick tube in bottom probe half and mate the probe halves. Coil wick inside reservoir and replace cover.
- 18) Replace four corner screws, rubber feet, and reservoir plug.

4.2 FACTORY CERTIFICATION AND RECERTIFICATION

Factory certification is initially provided at no charge with each new instrument. Since certification is typically good for one year, the instrument should be recertified by the factory on an annual basis. Generally, three temperature calibration points and three humidity check points are sufficient. If the instrument requires more than general cleaning, a reconditioning charge will also be applied. Consult the factory for current pricing information.

4.3 NIST CERTIFICATION AND RECERTIFICATION

If it is desired that the instrument be certified by the National Institute of Standards and Technology (NIST), all NIST charges are passed net plus 20% to the customer, plus F.O.B. charges to and from, plus insurance coverage.

In the case of NIST certification, it is recommended (although not required) that the instrument be sent to Thunder Scientific, so that NIST certification can be performed in conjunction with recommended annual factory calibration service.

RS-232 INTERFACE

5.1 GENERAL

Virtually all functions available through the keypad are also available through the RS-232 interface. Each command available over the RS-232 interface is included in Section 7 and is provided with a description, normal syntax and usage, and both computer and terminal communication examples. There are basically two types of commands available; one for input, one for output. Input commands consist of the basic command word, followed by a question mark (?), and are used to input information from the 5A-1MP to the computer or terminal.

Output commands consist of the basic command word, followed by an equals sign (=), and the numeric or string data, and are used to output information from the terminal or computer to the 5A-1MP. Spaces are completely ignored by the 5A-1MP and are neither acknowledged nor echoed. Errors in command syntax do not generate error messages. The command in error is simply ignored.

For wiring/cabling instructions, refer to Section 2.3.

5.2 RS-232 PROTOCOL

All commands and data sent to and from the 5A-1MP are done so at the following factory preset parameters:

Baud Rate:	1200 (Factory selectable from 300-9600)
Word Size:	8 Bits
Stop Bits:	1
Parity:	None

The 5A-1MP only requires one stop bit when receiving, but will use two stop bits while sending. The computer terminal may be set to either one or two stop bits, depending on user preference.

5.3 INITIALIZING THE HOST TERMINAL OR COMPUTER

Ensure that a computer/terminal is connected in accordance with Section 2.3. In order to communicate over the RS-232 interface, the terminal or computer must be configured to operate with the same protocol as that of the 5A-1MP. For the proper protocol parameters, refer to Section 5.2, RS-232 Protocol.

The following example illustrates the initialization for IBM BASICA when the 5A-1MP interface is connected to com1 of the computer.

```

10  'INIT ROUTINE FOR 5A-1MP TO COM1 CONNECTION.
20  'SET COM1 TO #1.
30  OPEN "COM1:1200,n,8,2,cs,ds,cd,rs" as #1
40  '
50  '
60  'NOW CLEAR 5A-1MP DATA BUFFERS
70  '
80  PRINT #1, CHR$ (3);
90  '
100 '
110 'DISABLE 5A-1MP ECHOING.
120 PRINT #1, "ECHO=OFF"
130 '
140 '
150 'WAIT A BIT.
160 FOR X=1 TO 50:NEXT X
170 '
180 'CHECK AND CLEAR COM1 INPUT BUFFER.
190 IF EOF(1) THEN 210
200 A$=INPUT$ (LOC(1), #1)
210 '
220 '
230 '
240 'INITIALIZATION COMPLETE. START COMMAND PROGRAMMING.
.
.
.

```

5.4 CLEARING THE 5A-1MP INPUT BUFFERS

After computer or terminal initialization and prior to actual communications between the terminal or computer and the 5A-1MP, the data I/O buffers of the 5A-1MP should be cleared. To clear the I/O buffers from a terminal, send a Control C or ASCII Code 3 (ETX).

To clear the I/O buffers from a computer, send a CHR\$ (3). For an example of this, see lines 60-80 of the initialization program of Section 5.3.

IEEE 488 INTERFACE

6.1 GENERAL

Virtually all functions available through the keypad are also available through the optional IEEE 488 interface. Each command used over this interface is included in Section 7 and is provided with a description, normal syntax and usage, and an HP BASIC example. There are basically two types of commands available; one for input, one for output. Input commands consist of the basic command word, followed by a question mark (?), and are used to input information from the 5A-1MP to the computer.

Output commands consist of the basic command word, followed by an equals sign (=), and the numeric or string data, and are used to output information from the computer to the 5A-1MP. Spaces are completely ignored by the 5A-1MP. Errors in command syntax do not generate error messages. The command in error is simply ignored.

6.2 IEEE 488 ADDRESSING

All 5A-1MP'S are initially set to an IEEE 488 address of 5 when originally shipped and during factory calibration/recalibration. The address is not hardware selectable, but is software selectable, and may be changed to any value between 0 and 9. Once changed, the new address becomes permanent (until changed again). Since this address is stored in non-volatile zero-power RAM, there is no limit to the number of times which the address may be altered. To change the address, refer to the **ADDR** command in Section 7. Note that the **SAVE** command does not affect the stored address.

6.3 CLEARING THE 5A-1MP I/O BUFFERS

After power-up, it is good practice to clear the 5A-1MP I/O buffers prior to beginning IEEE 488 communications.

Executing the HP BASIC command **CLEAR 7** clears all devices on the bus, while **CLEAR 705** clears the 5A-1MP only. Either is sufficient to clear the 5A-1MP I/O buffers.

The HP BASIC **CLEAR** command may also be used at any time to clear pending 5A-1MP outputs and garbage in the 5A-1MP input buffer due to aborted **OUTPUT 705** commands.

Refer to the following example:

```
10    ASSIGN @ PSY TO 705                !Set up communication path
20    CLEAR @ PSY                        !Clear 5A-1MP I/O buffers
.
.
.
```

COMMAND REFERENCE

7.1 GENERAL

The following is a comprehensive list of commands available over the RS-232 and IEEE 488 interfaces. Each of the commands is organized in alphabetical order on the remaining pages. Each command contains examples of its usage and proper syntax when connected to a computer on the IEEE 488 bus, or to a computer/terminal on the RS-232 interface. Note that only the first four characters of each command are actually required when communicating with the 5A-1MP, and additional characters are simply ignored.

Note also that each command ends with either a questions mark (?), (when requesting data from the 5A-1MP), or an equal sign (=) followed by data (when sending data to the 5A-1MP).

In general, commands which alter the psychrometer's configuration or calibration only remain in effect until power is removed or a cold reset is performed. However, all calibration coefficients, the printer configuration, the default pressure, and the IEEE 488 device address may be stored in non-volatile memory as the new power-up default values. Refer to the **ADDR**ess, **SAVE** and **REST**ore commands for further details.

COMMANDS GROUPED BY CATEGORY

Temp, RH, Dew Point	DRY Temp WET Temp RH DP
Saturation Vapor Pressures	DRY Svp WET Svp DPS Vp
SET Parameters	AVER age FLOW PRES sure PROB e
Real Time Clock	TIME DATE
Printer Control	PRIN t FORM feed HEAD er LIN Es END Line INTER val

Misc Control

AUTO
BLOWer
DEGRees
DISPlay
RESEt
RESTore
SAVE

Calibration Parameters

DRYOhms
WETOhms
DZERo
DSPAn
DLINearity
WZERo
WSPAn
WLINearity
DOZEro
DOSPAn
DOLInearity
WOZEro
WOSPAn
WOLInearity

RS-232 Parameters

ECHO

IEEE 488 Parameters

ADDRess

COMPLETE ALPHABETICAL COMMAND LISTING

<u>Command</u>	<u>Parameters</u>	<u>Description</u>
ADDR ess	0-9	IEEE 488 interface device selection address
AUTO	ON, OFF	Set/Read AUTO mode status
AVER age	Numeric	Set/Read amount of averaging
BLOW er	ON, OFF	Set/Read blower motor status
DATE	<i>mm/dd</i>	Set/Read date
DEGR ees	C, F	Set/Read temperature scale
DISP lay	0-9	Set/Read display parameter
DLIN earity	Numeric	Set/Read dry bulb linearity coefficient
DOLIN earity	Numeric	Set/Read dry ohms linearity coefficient
DOSP an	Numeric	Set/Read dry ohms span coefficient
DOZER o	Numeric	Set/Read dry ohms zero coefficient
DP	Numeric	Read dewpoint temperature
DPSV p	Numeric	Read dewpoint saturation vapor pressure
DRYOH ms	Numeric	Read dry bulb resistance
DRYSV p	Numeric	Read saturation vapor pressure @ dry bulb temp
DRYTemp	Numeric	Read dry bulb temperature
DSPAN	Numeric	Set/Read dry bulb span coefficient
DZERO	Numeric	Set/Read dry bulb zero coefficient
ECHO	ON, OFF	Set/Read RS-232 echoing status
ENDL ine	C, L, CL, LC	Set/Read printer end of line terminator sequence
FLOW	Numeric	Set/Read flow rate for external aspiration
FORM feed	ON, OFF	Set/Read printer formfeed status
HEAD er	ON, OFF	Set/Read printer header status
INTER val	<i>hh:mm</i>	Set/Read printer time interval
LINE s	Numeric	Set/Read printer lines per page
PRES sure	Numeric	Set/Read barometric pressure
PRIN t	ON, OFF, NOW	Set/Read printer status; force immediate print
PROBE	1-4	Set/Read selected probe #
RESE t	C	Execute cold reset, restores all power-up defaults
REST ore	<i>password</i> memory	Restore precalibration factory values to non-volatile memory
RH	Numeric	Read relative humidity
SAVE	<i>password</i> parameters to non-volatile memory	SAVE cal coefficients, pressure, printer control parameters to non-volatile memory
TIME	<i>hh:mm</i>	Set/Read time of day
WETOH ms	Numeric	Read wet bulb resistance
WETSV p	Numeric	Read saturation vapor pressure @ wet bulb temp
WETTemp	Numeric	Read wet bulb temperature
WLIN earity	Numeric	Set/Read wet bulb linearity coefficient
WOLIN earity	Numeric	Set/Read wet bulb ohms linearity coefficient
WOSP an	Numeric	Set/Read wet bulb ohms span coefficient
WOZER o	Numeric	Set/Read wet bulb ohms zero coefficient
WSPAN	Numeric	Set/Read wet bulb span coefficient
WZER o	Numeric	Set/Read wet bulb zero coefficient

AUTO

AUTO=ON	enables the AUTO mode of operation. It performs the same function as enabling the AUTO mode from the keypad.
AUTO=OFF (power-up default)	disables the AUTO mode of operation, performing the same function as disabling the AUTO mode from the keypad.
AUTO?	returns either ON or OFF , depending on the present status. The power-up default mode is OFF .

IBM BASICA Example (assuming com1 is initialized and 5A-1MP **ECHO=OFF** statement executed):

```
.  
. .  
100 PRINT #1, "AUTO=ON"           'Turn it on.  
110 PRINT #1, "AUTO?"           'Get status.  
120 INPUT #1, A$                 'A$ contains "ON".  
130 PRINT "AUTO MODE IS CURRENTLY "; A$ 'Display status message on monitor.  
140 PRINT #1, "AUTO=OFF"        'Turn it off.  
. .  
.
```

Line 100 enables the AUTO mode, illuminating the 3 leftmost dots on the lower LED display. If the **INTER**val has been changed to other than its 1 minute default, the dot on the left (blower motor indicator) will not yet be illuminated and the blower motor will remain off until 1 minute before print time. The second dot from the left indicates that the printer has been enabled. With AUTO mode enabled, the printer cannot be disabled by either the keypad or the **PRIN**ter command.

Line 110 asks for the current auto mode status. The 5A-1MP responds with **ON**, followed by a carriage return.

Line 120 accepts the word **ON** from the IBM serial input buffer.

Line 130 displays **AUTO MODE IS CURRENTLY ON** on the IBM monitor screen.

Line 140 disables the AUTO mode, disables the printer (causing a formfeed if formfeeds are enabled), and disables the blower after approximately 1 to 2 seconds. The 3 leftmost dots on the lower display will turn off.

TERMINAL Example (assuming **ECHO** is **ON**):

AUTO=ON	This turns it on.
AUTO?	Ask if it's on or off.
<i>ON</i>	It says it's on.
AUTO=OFF	Now turn it off.
AUTO?	Ask if it's on or off.

OFF

It says it's off.

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
100  OUTPUT 705; " AUTO = ON "           !Turn it ON.
110  OUTPUT 705; " AUTO? "             !Get Status.
120  ENTER 705; A$                     !A$ contains "ON".
130  DISP "AUTO MODE IS CURRENTLY"; A$  !Display status on display line.
140  OUTPUT 705; "AUTO = OFF"          !Turn it OFF.
```

Line 100 enables AUTO mode, illuminating the 3 leftmost dots on the lower LED display. If the **INTER**val has been changed to other than its 1 minute default, the dot on the left (blower motor indicator) will not yet be illuminated and the blower will remain off until 1 minute before print time. The second dot from the left indicates that the printer has been enabled. With AUTO mode enabled, the printer cannot be disabled by either the keypad or the **PRIN**ter command.

Line 110 asks for the current AUTO mode status. The 5A-1MP interprets the command and waits with the ON response.

Line 120 retrieves the response **ON** from the 5A-1MP.

Line 130 displays **AUTO MODE IS CURRENTLY ON** on the computer screen.

Line 140 disables the AUTO mode, disables the printer (causing a form feed if form feeds are enabled), and disables the blower after approximately 1 to 2 seconds. The 3 leftmost dots on the lower display will turn off.

RELATED COMMANDS:

BLOWer
INTERval
FLOW
PRINter

AVERage

AVER=number
(power-up default=0)

sets internal averaging to the specified number. The power-up default value is 0, and reasonable values are between 0 (no averaging) and 100 (lots of averaging). Negative values should not be used. Both standard and scientific notation are accepted.

AVER?

returns the numeric value of the currently specified averaging amount. The number is always returned in scientific notation with 8 digits of mantissa and a 2 digit exponent.

Note - While averaging is not normally used or required for stable readings, its use may prove beneficial in unstable and/or electrically noisy environments.

IBM BASICA Example (assuming com1 is initialized and **ECHO** is **OFF**):

```
.
.
.
100 PRINT #1, "AVER=5"           'Set it to 5 directly.
110 x=4                          'This way works too,
120 PRINT #1, "AVER="; x         'and sets it to 4.
130 PRINT #1, "AVERAGE=1.080E1" 'This also works, makes it 10.8.
140 PRINT #1, "AVERAGE?"       'Check value, should be 10.8.
150 INPUT #1, A$
160 N=VAL(A$)                    'N=10.8, A$=1.0800000E+01.
170 PRINT N, A$                 'Display both for verification.
```

Line 100 sets averaging to 5.

Lines 110, 120 set averaging to 4.

Line 130 uses scientific notation to set averaging to 10.8.

Lines 140-170 retrieve the averaging value, displaying

10.8 1.0800000E+01

on the monitor screen.

TERMINAL Example (assuming **ECHO** is **ON**):

```
AVERage?
0.0000000E+00
AVER=2.5
aver=0.06e2
AVER?
6.0000000E+02
```

This is the power-up default value.
Sets averaging to 2.5.
Sets averaging to 6.
Returns the value of 6 just entered.

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
100  OUTPUT 705; "AVER = 5"           !Set it to 5 directly.
110  X = 4                            !This way works too,
120  OUTPUT 705; "aver ="; X         !and sets it to 4.
130  OUTPUT 705; "AVERAGE - 1.080E1"!This makes it 10.8.
140  OUTPUT 705; "AVER?"           !Check its value,
150  ENTER 705; A$                  !should be 10.8.
160  DISP VAL(A$), A$              !Displays 10.8, 1.0800000E+01.
```

Refer to the IBM BASICA example for an explanation of the preceding program lines.

BLOWer

BLOW=ON

turns **ON** the blower (aspirator) motor within the probe. The leftmost dot on the lower LED display illuminates.

BLOW=OFF (power-up default)

turns off the blower (aspirator) motor within the probe housing (after about 1 second), and the leftmost dot on the lower LED display goes out. If **AUTO** mode is enabled, the blower will not turn off if the 5A-1MP is within 1 minute of printing a reading. With **AUTO=ON** and **INTERvals** get to 1 minute (00:01), the blower will not turn off at all and the **BLOW=OFF** command is ignored by the 5A-1MP.

BLOW?

returns either **ON** or **OFF**, depending on the present status. The power-up default is **OFF**.

IBM BASICA Example (assuming com1 is initialized and **ECHO** is **OFF**):

```
.
.
.
100 PRINT #1, "BLOW?"           'Is blower on? Let's find out.
110 INPUT #1, A$                'A$="ON" or "OFF".
120 IF A$="ON" THEN GOSUB 1000   'If it's ON, go check auto mode.
130 PRINT "BLOWER IS NOW OFF"   'The blower is definitely off now.
140 STOP

.
.
.
1000 PRINT #1, "AUTO?"          'Get status of auto mode.
1010 INPUT #1, A$
1020 IF A$="ON" THEN GOSUB 2000 'If "ON" then go shut it off.
1030 PRINT #1, "BLOW=OFF"      'Auto is OFF, so now shut off blower.
1070 RETURN

.
.
.
2000 PRINT #1, "AUTO=OFF"       'Shut OFF auto mode. Also shuts off
                                blower.
2010 RETURN

.
.
.
```

Lines 100, 110 retrieve the **BLOWer** status.

Line 120 checks to see if the **BLOWer** is **ON** or **OFF**. If **OFF**, then line 130 is executed. Note however, that if the **AUTO** mode is **ON**, the **BLOWer** may turn **ON** at any time.

If the **BLOWer** is **ON** at line 120, then lines 1000-1070 are executed in order to shut it off.

Lines 1000, 1010 retrieve the **AUTO** mode status.

Line 1020 checks the status and ensures that if **AUTO** mode is **ON**, it is shut **OFF** by line 2000, along with the blower motor.

Line 1030 shuts the **BLOWER** motor **OFF**, only if **AUTO** mode is **OFF**.

TERMINAL Example (assuming **ECHO** is **ON**):

BLOWER?	
<i>OFF</i>	This is the power-up default.
BLOW=ON	Turn it on.
BLOW?	Verify it.
<i>ON</i>	
BLOW=OFF	Turn it off.
BLOW?	Now check it.
<i>OFF</i>	
INTE?	
<i>00:01</i>	Default interval is 1 second.
AUTO=ON	Enable auto mode.
BLOW?	With auto mode enabled and interval at 1 second, blower is automatically turned on.
<i>ON</i>	

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.
.
.
100  OUPUTPUT 705; "AUTO = OFF; BLOW = OFF"           !Turn off Auto and Blower.
.
.
270  OUTPUT 705; "BLOW = ON; BLOWER?"               !Turn on, verify.
280  ENTER 705; B$
290  IF B $<>"ON" THEN DISP "PROGRAMMING ERROR"
.
.
520  OUTPUT 705; "BLOW = OF"                         !Only need first 2 letters of OFF.
```

RELATED COMMANDS:

AUTO
FLOW
INTErval

DATE

DATE=mm/dd sets the date to the desired month (*mm*) and day (*dd*). Use numeric values for *mm* between 1 and 12 inclusive. Use numeric values for *dd* between 1 and 31 inclusive. The "/" is used as a delimiter, however all of the following delimiters work equally well:

. , : - or /

DATE? returns the month (*mm*) and day (*dd*) in the format *mm/dd*.

IBM BASICA Example (assuming com1 is initialized and **ECHO** is **OFF**):

```
.
.
.
100 PRINT #1, "DATE=12/25"           'Make it Christmas.
.
.
.
200 PRINT #1, "DATE="; DATE$        'Synchronize 5A-1MP date to IBM date.
210 PRINT #1, "DATE?"              'Verify.
220 INPUT #1, A$                    'A$ contains only mm/dd. 5A-1MP ignores
                                     year.
230 PRINT DATE$, A$                 'Displays IBM date and 5A-1MP date.
```

Line 100 will set the date to December 25th.

Line 200 sets the date using the Date function of BASICA. The date\$ function gives the date as *mm/dd/yyyy*, but the 5A-1MP uses only the *mm/dd* portion of the string.

Lines 210-230 retrieve the new 5A-1MP date and display it alongside the IBM date. The monitor shows (as an example)

01-10-1989 **01/10**

for the 10th of January.

TERMINAL Example (assuming **ECHO** is **ON**):

DATE?	Retrieve the currently set date.
01/10	Assuming it's January 10th.
DATE=2/14	Valentines Day.
DATE?	
01/10	Didn't work; needs 02, not 2.
DATE=02/14	Try again.
DATE?	
02/14	Worked?

DATE=07/04/1776
DATE?
07/04

Independence Day.
Always ignores the year.

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

200	OUTPUT 705; "DATE?"	!Ask for Date.
210	ENTER 705; D\$!Read it in.
220	DISP D\$!Display on computer screen.
.		
.		
690	OUTPUT 705; "DATE = 12-31; TIME = 23:59:59"	!Happy New Year!

RELATED COMMANDS:

TIME

DEGRees

DEGR=C changes both the LED display and the printer to output temperatures in degrees centigrade. The rightmost dot on the lower display illuminates.

DEGR=F (power-up default) changes both the LED display and the printer to output temperatures in degrees Fahrenheit. The rightmost dot on the lower display goes out. This is the power-up default mode.

DEGR? returns either **C** or **F**, depending on the current status.

*Note - Temperatures obtained over the serial and IEEE 488 communications links are always in degrees C, regardless of the setting of the **DEGR** command. The **DEGR** command affects only the LED display and printer.*

IBM BASICA Example (assuming com1 is initialized and 5A-1MP **ECHO** is **OFF**):

```
.  
. .  
100 PRINT #1, "DEGR=C"           'Put printer/display in °C.  
200 PRINT #1, "DEGR?"           'Verify.  
300 INPUT #1, A$                 'A$="C".  
400 PRINT "5A-1MP is displaying and  
    printing in degrees"; A$  
. .  
. .  
. .
```

Line 100 puts the 5A-1MP in the degrees **C** mode.

Lines 200-400 retrieve the current degrees mode, displaying

5A-1MP is displaying and printing in degrees C

on the computer monitor.

TERMINAL Example (assuming **ECHO** is **ON**):

DEGR?	
<i>F</i>	Power-up default.
DEGREES=C	Set to degrees C.
DEGR?	Verify.
<i>C</i>	
DEGR=F?	Change and verify in one step.
<i>F</i>	

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.  
. 300  OUTPUT 705; "DEGREES = F"           !Put printer/disp in •F.  
.  .  
.  .  
. 580  OUTPUT 705; "DEGR = C?"           !Change and verify in same command.  
590  ENTER 705: A$                       !Read in "F".  
600  DISP A$                             !Displays F.  
.  .  
.  .  
.  .
```

DISPlay

DISP=*n* (power-up default=7) changes the LED display to parameter *n*. This is identical to displaying the desired parameters by pressing the corresponding keys on the numeric keypad (parameters are written below the numbers in black) of the 5A-1MP. The number *n* and the parameters relate in the following manner:

<i>n</i>	<u>Parameter</u>
0	Probe selected
1	RH
2	Dewpoint
3	Dry Bulb Temperature
4	Wet Bulb Temperature
5	Dry Bulb Ohms value
6	Wet Bulb Ohms value
7	Time
8	Date
9	Interval

*Note - Only the first digit of the integer value *n* is accepted, all others are ignored. A non-numeric value in the first digit of *n* will cause the entire command to be ignored.*

DISP? return an integer number (0-9) which corresponds to the currently displaying parameter. (See parameter list above).

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.  
. .  
100 PRINT #1, "DISP=1"           'Display RH on upper LED, P--1 on lower  
                                LED.  
. .  
200 PRINT #1, "DISPLAY?"        'Get current display parameter.  
210 INPUT #1, A$                'A$="0", "1", ..."8", or "9".  
220 D=VAL (A$)                  'Convert to numeric value.  
230 PRINT #1, "DISP="D+1 MOD(10) 'Display next parameter in sequence.  
. .  
. .
```

Line 100 sets display to 1, which is RH.

Lines 200, 210 retrieve the current display number.

Line 220 converts the value to numeric.

Line 230 increments the display to the next number. The MOD(10) causes 9+1 to equal 0 rather than 10.

TERMINAL Example (assuming **ECHO** is **ON**):

DISP?		
7		Power-on default value, the time.
DISPLAY=8		Show date on LED display.
DISP=2		Show Dewpoint temperature on LED display.
DISP?	Verify.	
2		Yes, it's correct.

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.  
. 100  OUTPUT 705; "DISP = 1"           !Display RH.  
. 330  OUTPUT 705; "DISPLAY?"         !Which one?  
340  ENTER 705; A  
350  DISP "LED'S ARE SHOWING PARAMETER"; A !Tell operator.
```

DLINearity (Dry Bulb Linearity Coefficient)

DLIN=number is used during factory calibration only, and temporarily changes the LINEARITY coefficient of the Dry Bulb temperature formula. The *number* stored is valid only until power is removed, the **RESET=C** command is issued, the probe number is changed from the keypad, or the **PROBE** command is used. The *number* is entered in either standard or scientific notation. The power-up default value is determined during factory calibration and stored in non-volatile memory. Refer to the **RESTore** and **SAVE** commands to alter the non-volatile memory for the linearity coefficient of the currently selected probe.

DLIN? returns the LINEARITY coefficient of the Dry Bulb temperature formula of the currently selected probe.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.
.
.
100 PRINT #1, "DLIN?"           'Read current value.
110 INPUT #1, A$
120 OLD.NUM=VAL(A$)           'Convert to numeric.
.
.
.
200 NEW.NUM=FN...             'Calculate a new coefficient.
210 PRINT #1, "DLIN="; NEW.NUM 'Send new coefficient to 5A-1MP.
.
.
.
```

TERMINAL Example (assuming **ECHO** is **ON**):

```
DLIN?
8.2440000E-05           Power-up default of an uncalibrated unit.
DLINEARITY=.000087654321 Send new coefficient, standard notation.
DLIN?
8.7654321E-05           Verify.
DLIN=.8877665e-4?     Send and verify in same step.
8.8776650E-05
```

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
100 OUTPUT 705; "DLIN?"           !Read value.
```

110 ENTER 705; X
120 DISP X

!Display it.

RELATED COMMANDS:

DSPAn
DZERo
PROBE
RESTore
SAVE

DOLInearity (Dry Ohms Linearity Coefficient)

DOLI=number is used during factory calibration only, and temporarily changes the LINEARITY coefficient of the Dry Bulb ohms formula. The *number* stored is valid only until power is removed, the **RESET=C** command is used, or a cold reset is executed from the keypad. The *number* is entered in either standard or scientific notation. The power-up default value is determined factory calibration and stored in non-volatile memory. Refer to the **RESTore** and **SAVE** commands to alter non-volatile memory.

DOLI? returns the LINEARITY coefficient of the Dry Bulb ohms formula.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.
.
.
100 PRINT #1, "DOLI?"           'Read current value.
110 INPUT #1, A$
120 OLD.OHM.LIN=VAL (A$)       'Convert to numeric.
.
.
.
200 PRINT #1, "DOLI=7.7827037E-5?" 'Send and request in same line.
210 INPUT #1, A$
220 PRINT VAL (A$)             'Displays .000077827037.
```

TERMINAL Example (assuming **ECHO** is **ON**):

```
DOLI?
0.0000000E+00           Power-up default of an uncalibrated unit.
DOLI=.079182456E-3    Change value.
DOLI?                Read it back.
7.9182456E-05
```

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
100 OUTPUT 705; "DOLINEARITY?"           !Get value.
110 ENTER 705; Dry_ohm_lin
.
.
.
300 OUTPUT 705; "DOLIN = 7.7827037E-5"    !Change it.
```

RELATED COMMANDS:

DOSPan
DOZEro
RESTore
SAVE

DOSPan (Dry Ohms Span Coefficient)

DOSP=number is used during factory calibration only, and temporarily changes the SPAN coefficient of the Dry Bulb ohms formula. (Refer to **DOLI** command).

DOSP? returns the SPAN coefficient of the Dry Bulb ohms formula.

IBM BASICA Example (Refer to **DOLI** command).

TERMINAL Example (Refer to **DOLI** command).

IEEE 488 Example (Refer to **DOLI** command)

RELATED COMMANDS:

DOLinearity
DOZEro
RESTore
SAVE

DOZEro (Dry Ohms Zero Coefficient)

DOZE=number is used during factory calibration only, and temporarily changes the ZERO coefficient of the Dry Bulb ohms formula. (Refer to **DOLI** command).

DOZE? returns the ZERO coefficient of the Dry Bulb ohms formula.

IBM BASICA Example (Refer to **DOLI** command).

TERMINAL Example (Refer to **DOLI** command).

IEEE 488 Example (Refer to **DOLI** command).

RELATED COMMANDS:

DOLInearity
DOSPan
RESTore
SAVE

DP

(Dew Point Temperature)

DP?

returns the currently measured dewpoint temperature. Dewpoint temperature is calculated from the Dry Bulb temperature, Wet Bulb temperature, and the barometric pressure, and is relative only to that pressure. All temperatures are returned in degrees C only regardless of the status returned by the **DEGR?** command. Temperatures are also returned in 8 digit scientific notation.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.
.
.
100 A$="DP?"           'Want dewpoint.
110 GOSUB 200          'Go request it.
120 PRINT "DEWPOINT TEMPERATURE IS"; A$ 'Prints on monitor.
.
.
.
200 PRINT #1, A$      'Send DP? command.
210 INPUT #1, A$      'Read in response.
220 RETURN            'A$=n.nnnnnnnE±nn.
```

TERMINAL Example (assuming **ECHO** is **ON**):

DP?

1.0254716E+01

Get the dewpoint.

Returns current measured dewpoint. This example returned 10.25°C. The 8 digit output resolution is merely a mathematical convention and is not indicative of increased measurement accuracy.

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.
.
.
100 OUTPUT 705; "DP?"
110 ENTER 705; Dew_point
120 DISP "DEWPOINT "; Dew_Point; "°C"
.
.
.
```

DPSVp

(Dew Point Saturation Vapor Pressure)

DPSV?

returns the current dewpoint Saturation Vapor Pressure in inches of mercury. All saturation vapor pressures are returned in inches of mercury in 8 digit scientific notation.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.  
. .  
100 PRINT #1, "DPSV?"           'Request DP SVP value.  
110 INPUT #1, A$                'Read in SVP.  
120 SVP=VAL(A$)                 'Convert to numeric.  
130 PASCAL=SVPx3386.39          'Convert from in Hg to Pa.  
140 PRINT "DP SAT VAPOR PRESSURE IS"; 'Print Vapor Press in Pascals.  
    PASCAL;"PA"  
. .  
.
```

TERMINAL Example (assuming **ECHO** is **ON**):

```
DPSV?                               Request Dewpoint Sat Vapor Pressure.  
3.4279811E-01                         DPSVp returned .34279811 in Hg for this  
                                        example.
```

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.  
. .  
100 OUTPUT 705; "DP?; DPSVp?"       !Read them both.  
110 ENTER 705; Dew_Point, Vapor_press  
120 DISP Dew_Point, Vapor_press     !Display them both.  
. .  
.
```

DRYOhms (Dry Ohms)

DRYO? is used only during factory calibration, and returns the measured resistance of the Dry Bulb in ohms. All ohms values are returned in 8 digit scientific notation. Values returned should be between 440 and 690 Ω .

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.  
. .  
100 PRINT #1, "DRYO?"           'Request value.  
110 INPUT #1, A$               'Read it in.  
120 DRY.OHMS=VAL (A$)          'Make it numeric.  
. .  
. .  
. .
```

TERMINAL Example (assuming **ECHO** is **ON**):

```
DRYOhms?           Request value.  
6.7844999E+02      678.44999  $\Omega$  for this example.
```

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
. .  
100 OUTPUT 705; "DRYO?"       !Get Dry Ohms value.  
110 ENTER 705: X  
. .  
. .  
. .
```

DRYSvp

(Dry Bulb Saturation Vapor Pressure)

DRYS?

returns the current Saturation Vapor Pressure at the Dry Bulb temperature in inches of mercury. All saturation vapor pressures are returned in inches of mercury in 8 digit scientific notation.

IBM BASICA Example (Refer to **DPSV** command).

TERMINAL Example (Refer to **DPSV** command).

IEEE 488 Example (Refer to **DPSV** command).

DRYTemp (Dry Bulb Temperature)

DRYT? returns the current Dry Bulb temperature. All temperatures are returned in degrees centigrade, in 8 digit scientific notation.

IBM BASICA Example (Refer to **DP** command).

TERMINAL Example (Refer to **DP** command).

IEEE 488 Example (Refer to **DP** command).

DSPAn

(Dry Bulb Span Coefficient)

DSPA=number

is used during factory calibration, and temporarily changes the SPAN coefficient of the Dry Bulb temperature formula. The *number* stored is valid until power is removed, the **RESET=C** command is used, the **PROBe** command is used, the probe number is set or changed from the keypad, or a cold reset is executed from the keypad. The power-up default value is determined during factory calibration and permanently stored in non-volatile memory. Refer to the **REStore** and **SAVE** commands to alter non-volatile memory.

DSPA?

returns the SPAN coefficient of the Dry Bulb temperature formula of the currently selected probe.

IBM BASICA Example (Refer to **DLIN** command).

TERMINAL Example (Refer to **DLIN** command).

IEEE 488 Example (Refer to **DLIN** command).

RELATED COMMANDS:

DLINearity
DZERo
PROBE
REStore
SAVE

DZERO

(Dry Bulb Zero Coefficient)

DZER=number

is used during factory calibration, and temporarily changes the SPAN coefficient of the Dry Bulb temperature formula. The *number* stored is valid until power is removed, the **RESET=C** command is used, the **PROB=n** command is used, the probe number is set or changed from the keypad, or a cold reset is executed from the keypad. The power-up default value is determined during factory calibration and permanently stored in non-volatile memory. Refer to the **RESTore** and **SAVE** commands to alter non-volatile memory.

DZER?

returns the ZERO coefficient of the Dry Bulb temperature formula of the currently selected probe.

IBM BASICA Example (Refer to **DLIN** command).

TERMINAL Example (Refer to **DLIN** command).

IEEE 488 Example (Refer to **DLIN** command).

RELATED COMMANDS:

DLINearity
DSPAN
PROBe
RESTore
SAVE

ECHO

(RS-232 only)

ECHO=ON (power-on default)

enables the 5A-1MP echoing feature. This mode is useful for connection of the 5A-1MP to a computer terminal operating in full duplex. In ECHO mode, all valid characters sent to and accepted by the 5A-1MP are echoed back to the host terminal. When a carriage return (CHR (13)) is sent by the host terminal signalling the end of a command line, the 5A-1MP echoes it back and also sends a line feed (CHR (10)) to advance the terminals cursor to the next line to prevent overwriting of information on the terminal screen. Each 5A-1MP response to a ? command is also appended with a line feed following the carriage RETURN, again to advance the terminals cursor to the next line.

ECHO=OFF

disables the 5A-1MP echoing feature, and is intended for use when operating the 5A-1MP from within a BASIC (or other language) program. In this mode, nothing is sent from the 5A-1MP except requested information (from the ? commands). Each string of information sent from the 5A-1MP is appended with only a carriage return to signal the end of line. No line feeds are sent. This ensures compatibility with IBM's BASICA PRINT# and INPUT# statements.

ECHO?

returns either **ON** or **OFF**, depending on the status. If **ECHO** is **ON**, a line feed character is also sent following **ON «CR»**.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
10 OPEN "COM1"9600,n,8,2,cs,cd,ds,rs" as #1      'Init com port.
20 PRINT #1, "ECHO=OFF"                          'Disable echo mode.
30 IF NOT EOF(1) THEN A$=INPUT$(LOC(1), #1)      'Clear IBM serial input buffer.
.
.
.
100 PRINT #1, "DRYT?"                             'Now, ready to roll.
110 INPUT #1, A$                                  'Get dry temp.
.
.
.
1000 FAKE TERMINAL MODE                          'Simulate terminal mode.
1010 PRINT #1, "ECHO=ON"                          'Re-enable echo mode.
1020 A$=INKEY$:IF A$<>""THEN PRINT #1, A$;        'Scan IBM keyboard for output.
1030 IF EOF(1) THEN 1020                          'Check serial port for input.
1040 A$=INPUT$(LOC(1), #1)                        'Read in serial port stuff.
1050 PRINT A$;                                    'Display it.
1060 GOTO 1020                                    'Loop back to keyboard scan.
```

TERMINAL Example (assuming **ECHO** is **ON**):

ECHO?

ON

ECHO=OFF

>>>>

Power-on default mode.

Turn it off.

Information is overwritten because no line feeds.

Executing **ECHO=ON** restores normal operation.

ENDLine (End of Line)

ENDL=C (factory default) causes each line sent to the printer to end with a carriage return (CHR\$ (13)) only.

ENDL=L causes each line sent to the printer to end with a line feed (CHR\$ (10)) only.

ENDL=CL causes each line sent to the printer to end with a carriage return and a line feed (CHR\$ (13); CHR\$ (10)).

ENDL=LC causes each line sent to the printer to end with a line feed and a carriage return (CHR\$ (10); CHR\$ (13)).

Note: Refer to **RESTore** and **SAVE** commands to alter the default in non-volatile memory.

ENDL? returns **C**, **L**, **CL**, or **LC**, depending on the present setting.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.
.
100 PRINT #1 "ENDLINE?"           'Get present setting.
110 INPUT #1, A$                 'A$="C", "L", "CL", or "LC".
120 IF MID$(A$,1,1)=C THEN PRINT "CARRIAGE
RETURN" ELSE PRINT "LINE FEED"
130 IF LEN(A$)=1 THEN PRINT "ONLY.": GOTO 150
140 IF MID$(A$,2,1)=C THEN PRINT " AND
CARRIAGE RETURN." ELSE PRINT "AND
LINE FEED"
.
.
.
200 PRINT #1, "ENDL=CL"          'Setting for many IBM compatible printers.
```

TERMINAL Example (assuming **ECHO** is **ON**):

ENDL?	Request setting.
<i>C</i>	Power-up default.
ENDLINE=LINE FEED	
ENDL?	Request setting.
<i>L</i>	Ignored extra chrs after "l" in "line feed".
ENDL=LC	Set to line feed, carriage return.
ENDL?	Verify it.
<i>LC</i>	It worked.

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.  
. .  
100  OUTPUT 705; "ENDL?"           !Get present setting.  
110  ENTER 705; A$                !A$ = "C", "L", "CL", or "LC".  
. .  
200  OUTPUT 705; "ENDLINE = CL"   !Sends carriage return - linefeed after each  
                                     printed line.
```

RELATED COMMANDS:

PRINt
RESTore
SAVE

FLOW

(Flow Rate)

FLOW=number
(power-up default=140)

changes the flow rate parameter from its default setting to the *number* entered. This command is used when aspirating the psychrometer probe from an external source such as a Model 8500 or Model 9000 automated two-pressure humidity generators. Utilizing this command to inform the 5A-1MP of the present flow rate, the psychrometer may be aspirated by the humidity generator at any flow rate between 60 and 140 standard liters per minute (SLPM), while still maintaining accurate relative humidity measurements. The *number* is entered in either standard or scientific notation. Whenever the probe is aspirated internally, by turning ON the blower motor, the flow value stored by the **FLOW** command is not used in any relative humidity calculations. Instead, an internally stored value is used which relates to the flow rate of the blower motor (usually 140 SLPM). (This internal blower motor flow rate value is not accessible or alterable except during factory calibration). Whenever the internal blower is turned off, the 5A-1MP returns to using the value stored by the **FLOW** command in its relative humidity calculations.

FLOW?

returns the currently stored flow rate value which is used for relative humidity calculations when the blower is OFF and the probe is aspirated from an external source of known flow rate. The number returned is in 8 digit scientific notation.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.  
. .  
100 PRINT #1 "AUTO=OFF"           'Ensures auto and blower are off.  
110 PRINT #1, "FLOW=100"         'Aspirated by Model 7000 RH generator at  
                                100 SLPM.  
. .  
150 PRINT #1, "FLOW?"           'Get flow rate setting.  
160 INPUT #1, A$                 'A$="1.0000000E+02" for this example.  
170 PRINT "FLOW RATE SETTING IS"; VAL(A$); 'Print on monitor.  
    "SLPM"
```

TERMINAL Example (assuming **ECHO** is **ON**):

FLOW?
1.4000000E+02
FLOW=100
FLOW?

Power-up default value.
Set to 100 SLPM.
Check it.

1.0000000E+02

AUTO?

OFF

BLOW?

ON

BLOW=OFF

OK, it's 100 SLPM.

Make sure auto and blower are OFF.

If it's on, then let's turn it OFF.

Now 100 SLPM will be used in RH calcs.

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.  
. 100  OUTPUT 705; "AUTO = OFF"           !Ensures AUTO and BLOWer are OFF.  
110  OUTPUT 705; "FLOW =100"           !Aspirated by Model 8500 RH generator at  
                                         100 SLPM  
. 150  OUTPUT 705; "FLOW?"             !Get flow rate setting.  
160  ENTER 705; Flow_rate              !Put into variable.  
. 160  
. 160  
. 160
```

RELATED COMMANDS:

AUTO

BLOWer

FORMfeed

FORM=ON
(factory default)

causes a formfeed character (CHR\$ (12)) to be sent to the printer at the end of each page, advancing the printer to the top of the next page. Each time the printer is disabled from either the **PRIN=OFF** command or from the keypad, a formfeed will also be sent, advancing the printer to the top of the next page (often called top of form). Changes may be made permanent through the use of the **SAVE** command.

FORM=OFF

prevents formfeeds (CHR\$ (12)) from being sent to the printer. With formfeeds disabled, the printer may be turned on and off repeatedly without wasting paper. (Refer to **HEADer** command).

FORM?

returns either **ON** or **OFF**, depending on the present status.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.  
.
100 PRINT #1, "FORM=OF"           'Only need first 2 letters in "OFF".
.  
.
200 PRINT #1, "FORM?"           'Get formfeed status.
210 INPUT #1, A$                'A$="ON" or "OFF".
220 PRINT "PRINTER FORMFEEDS ARE
    TURNED"; A$
.  
.
.
```

TERMINAL Example (assuming **ECHO** is **ON**):

FORM?	Check status.
<i>ON</i>	Power-up default.
FORMfeed=OFF	Disable formfeeds to printer.
FORM?	Verify.
<i>OFF</i>	OK, it's OFF.

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.  
.
100 OUTPUT 705; "FORMFEEDS?"     !Request status.
```

110	ENTER 705; A\$!A\$ = "ON" or "OFF".
120	DISP "Formfeeds are "; A\$!Display status on screen.
.		
.		
.		
900	OUTPUT 705; "FORM = ON; HEAD=ON"	!Turn form feeds ON, turn header ON.

RELATED COMMANDS:

HEADer
PRINt
RESTore
SAVE

HEADer

HEAD=ON
(factory default)

causes the printer to print a column heading at the top of each page. If **FORM=OFF** has been executed, the header may occur anywhere on the page since the printer is not advancing to the top of each new page. With **HEADer** enabled, a new header is also printed each time the printer is re-enabled from either the keypad or the **PRINt =ON** command. Changes may be made permanent through the use of the **SAVE** command.

HEAD=OFF

prevents column headings from printing. This is useful in conjunction with **FORM=OFF** when the printer is to be repeatedly turned on for only short periods of time, and all information is desired on the same page.

HEAD?

returns either **ON** or **OFF**, depending on the present status.

IBM BASICA Example (Refer to **FORM** command).

TERMINAL Example (Refer to **FORM** command).

IEEE 488 Example (Refer to **FORM** command).

RELATED COMMANDS:

FORMfeed
PRINt
RESTore
SAVE

INTERval

INTE=hh:mm
(power-up default=00:01) sets the time interval between printouts. Whenever the printer is enabled or the 5A-1MP is operating in AUTO mode, printer output will occur at the specified intervals. The format is in hours (*hh*) and minutes (*mm*), separated by a delimiter (. , : - or /). Print intervals can range from a minimum of one minute (00:01) to a maximum of 23 hours and 59 minutes (23:59).

INTE? returns the current interval setting. It is returned in the format *hh:mm* where *hh* is in hours and *mm* is in minutes.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.  
. .  
100 PRINT #1, "INTERVAL=00:05"           'Set print interval to 5 minutes.  
110 PRINT #1, "PRINTER=ON"              'Turn on printer. Prints every 5 minutes.  
. .  
. .
```

TERMINAL Example (assuming **ECHO** is **ON**):

INTE?	Request interval time.
00:01	Power-up default value.
INTE=01:00	Set interval to 1 hour.
AUTO=ON	Take automatic readings each hour.

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.  
. .  
100 OUTPUT 705; "INTE?"                   !Get current print interval.  
110 ENTER 705; T$  
120 DISP "PRINT INTERVAL (HH:MM); T$"     !Display it.  
. .  
740 A$ = "00:10"  
750 OUTPUT 705; "INTE=";A$;"AUTO=ON"     !Print once every 10 min in AUTO mode.
```

RELATED COMMANDS:

AUTO
PRINt

LINES

(Lines per page)

LINE=number
(factory default=60)

sets the number of lines per page for the printer. If both **HEADer** and **FORMfeed** are disabled, the number of lines per page is insignificant since no page separation is accomplished. The *number* may be entered in either standard or scientific notation, but fractional numbers are truncated to the greatest integer. Changes may be made permanent through the use of the **SAVE** command.

LINE?

returns the current lines per page setting. The number returned is an integer in 8 digit scientific notation.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.  
. .  
100 PRINT #1, "LINE?"           'Get # of lines per page.  
110 INPUT #1, A$                'A$="6.0000000E+01". Default value.  
. .  
200 PRINT #1, "LINES=66"        'Set to 66 lines per page.  
. .  
.
```

TERMINAL Example (assuming **ECHO** is **ON**):

```
LINES?           Get # of lines per page.  
6.0000000E+01     Power-up default is 60.  
LINE=35.2        Try setting to fractional #.  
LINES?           See what it is now.  
3.5000000E+01     Only kept integer part, 35.
```

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.  
. .  
280 OUTPUT 705; "LINES =30;INTE =00:02;PRIN=ON" !Gives new page each hour.  
. .  
660 OUTPUT 705; "LINE?"           !Get value.  
670 ENTER 705; x  
680 OUTPUT 705; "LINE ="; x + 10   !Increase by 10 lines per page.
```

RELATED COMMANDS:

FORMfeed
HEADer
PRINt
RESTore
SAVE

PRESsure

PRES=number
(factory default=
29.92 in Hg)

is used to inform the 5A-1MP of the barometric pressure (in inches of mercury) of the environment being sample. The pressure is required for accurate calculation of the relative humidity and the dewpoint temperature. The number may be entered in either standard or scientific notation. Changes may be made permanent through the use of the **SAVE** command.

PRES?

returns the currently stored barometric pressure value used for the calculation of relative humidity and dewpoint temperature. It is returned in inches of mercury in 8 digit scientific notation.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.  
. .  
100 INPUT "WHAT IS THE CURRENT BARO      'Get current pressure from operator.  
    PRESSURE", BP  
110 PRINT #1, "PRES="; BP                'Send to 5A-1MP.  
. .  
.
```

TERMINAL Example (assuming **ECHO** is **ON**):

PRES?	Get last pressure stored.
2.9920000E+01	29.92 is power-up default value (sea level).
PRESsure=24.43	Set to 24.43 inches of mercury.
PRES?	Verify.
2.4430000E+01	OK.

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.  
. .  
100 INPUT "WHAT'S THE PRESSURE (PSIA)?"; P !Determine pressure.  
110 OUTPUT 705; "PRES = "; P*2.03602      !Tell 5A-1MP.  
. .  
.  
400 OUTPUT 705; "PRES?"                  !Retrieve pressure setting.  
410 ENTER 705; P  
420 DISP "PRESSURE STORED AS "; P; " " "HG" !Display in "Hg."
```

RELATED COMMANDS:

RESTore
SAVE

PRINt

- PRIN=ON** enable the printer to print at specified time intervals. (Refer to **INTERVAL** command). The first line is printed immediately. The printer is also enabled by the **AUTO=ON** command, however the first line is not printed until the specified time interval.
- PRIN=OFF** disables the printer. If **AUTO** mode is **ON**, this command will not work since it is over-ridden by the auto mode. Executing **AUTO=OFF** will also disable the printer. If **FORMfeed** is **ON**, a formfeed (CHR\$ (12)) will be sent to the printer to execute a "top of form" each time the printer is disabled by either the **PRINt** or **AUTO** command.
- PRIN=NOW** sends one line of data to the printer immediately, regardless of whether the printer is currently enabled or disabled. This is identical to pressing the "PRINT NOW" key on the keypad. Using this function does not disturb normal printing intervals or alter the lines per page setting.
- PRIN?** returns either **ON** or **OFF**, depending on the current status.
-

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.
.
.
100 PRINT #1, "PRIN=NOW"           'Print once immediately.
.
.
.
200 PRINT #1, "PRIN=ON"           'Turn on printer. Prints one immediately.
210 PRINT #1, "INTERVAL=00.02"    'Print every other minute.
.
.
.
300 PRINT #1, "PRIN=NOW"         'Sneak in an extra one.
.
.
.
```

TERMINAL Example (assuming **ECHO** is **ON**):

PRINter?	Get status.
<i>OFF</i>	Power-up default.
AUTO=ON	Enable auto mode.
PRIN?	Check status.
<i>ON</i>	Auto mode enables printer.

PRIN=OFF		Try turning it off.
PRINT?		Verify.
<i>ON</i>		Can't do it with auto ON.
AUTO=OFF		Disable auto.
PRIN?	Check.	
<i>OFF</i>		AUTO=OFF disables printer, too.

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```

100  OUTPUT 705; "PRINT = NOW"           !Print 1 line now.
.
.
.
400  OUTPUT 705; "PRINTER?"             !Get status.
410  ENTER 705; P$
420  IF P$ = "ON" THEN OUTPUT 705; "PRIN=OF" !Turn it off.
.
.
.

```

RELATED COMMANDS:

AUTO
ENDLine
FORMfeed
HEADer
INTERval
LINEs

PROBE

(Probe Number)

PROB=*n*
(power-up default=1)

sets the active probe and initializes the 5A-1MP with the specific calibration coefficients which correspond to the probe number *n*. A maximum of 4 probes (numbered 1 through 4) may be supplied with the 5A-1MP, the number of each indicated on the identification plate on top of the probe. When entering the probe number *n*, only the first digit following the equal sign is checked, and must be a 1, 2, 3, or 4. Anything else is invalid and causes the command to be ignored.

PROB?

returns **1, 2, 3, or 4**, depending on which probe has been set as active.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.
.
.
100 INPUT "PLEASE INSTALL PROBE 3.          'Prompt a change.
    HIT ENTER WHEN READY", A$
110 PRINT #1, "PROB=3"                    'Set to probe 3.
.
.
.
1000 PRINT #1, "PROB?"                    'Get active probe #.
1010 INPUT #1, A$                          'A$="1", "2", "3", or "4".
1020 INPUT "WHICH PROBE IS CONNECTED?",    'Ask operator to look.
    PROBE.NUM
1030 IF VAL(A$)=PROBE.NUM THEN GOTO 1070  'Do they match?
1040 PRINT "PROBE MISMATCH"                'Warning!
1050 PRINT "INITIALIZING 5A-1MP TO PROBE   'Corrective action.
    #"; PROBE.NUM
1060 PRINT #1, "PROBE="; PROBE.NUM        'Tell 5A-1MP.
1070 PRINT "OK. WE'RE READY"
.
.
.
```

TERMINAL Example (assuming **ECHO** is **ON**):

PROBE?	Get #.
<i>1</i>	Power-up default.
PROB=2	Change to 2.
PROB?	Verify.
<i>2</i>	OK.
PROB=4?	Change and request in same command.
<i>4</i>	OK, change was made.
PROB=5	Try setting to 5.
PROB?	Verify.
<i>4</i>	Only 1 through 4 valid, command was ignored.

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.  
. .  
100  OUTPUT 705; "PROBE?"           !Get probe #.  
110  ENTER 705; Pn  
120  DISP "5A-1MP IS SET TO PROBE #"; Pn  !Display it.  
. .  
500  INPUT "WHICH PROBE IS INSTALLED?", Pn  !Ask user which one.  
510  OUTPUT 705; "PROBE = "; Pn          !Tell 5A-1MP.
```

RESEt

RESE=COLD initiates a cold restart of the 5A-1MP, just as if power had been cycled off and on. All parameters are restored to their power-up default conditions, and communications buffers are cleared.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.  
. .  
1000 PRINT #1, "RESET=COLD"           'Restore default parameters (including  
                                       ECHO=ON).  
1010 PRINT #1, "ECHO=OFF"             'Turn echo back off.  
1020 A$=INPUT$ (LOC (1), #1)         'Clear computer's buffer.  
. .  
.
```

TERMINAL Example (assuming **ECHO** is **ON**):

RESET=C Restore all defaults to power-up values. Clear buffers.

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.  
. .  
800 OUTPUT 705; "RESE=C"             !Execute cold reset.  
. .  
.
```

RESTore

REST = *password* restores all calibration coefficients and configuration parameters to their pre-calibration factory default values. The *password*, 5A1MP, is required in order to prevent accidental restoration. This command overwrites non-volatile memory and is typically only used during initial factory calibration of the unit. If this command is inadvertently used, all parameters listed on the Calibration Data sheet supplied with the unit will be erased from memory and will require that they be re-input. Refer to the **SAVE** command.

Affected values include ohms coefficients, temperature coefficients for all 4 probes, printer configuration, pressure, and IEEE 488 address.

Printer restores to

Header = ON
Form feeds = ON
End of Line = Carriage return only
Lines/page = 60

Pressure restores to 29.92 "Hg

IEEE 488 Address restores to 5.

IBM BASICA Example (assuming COM1 is initialized to #1 and 5A-1MP **ECHO** is OFF):

```
.  
. .  
100 PRINT #1, "REST=5A1MP"           'Purge memory, restore pre-calibration  
                                       coefficients, etc.  
. .  
.
```

TERMINAL Example (assuming **ECHO** is ON):

RESTORE - 5A1MP All precalibration values restored to non-volatile
memory

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.  
. 100  OUTPUT 705; "REST=5A1MP"          !Purge memory, restore pre-cal coefficients,  
                                         etc.  
.  .  
.  .
```

RELATED COMMANDS:

SAVE

RH (Relative Humidity)

RH? returns the current relative humidity which is calculated from the Dry Bulb temperature, Wet Bulb temperature, barometric pressure, and flow rate. (Refer to **PRÉ**SSure and **FLOW** commands). Relative humidity is returned in 8 digit scientific notation.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.  
. .  
100 PRINT #1, "RH?"           'Get RH.  
110 INPUT #1, A$  
120 PRINT "RELATIVE HUMIDITY IS ";A$;"%" 'Display it.  
. .  
.
```

TERMINAL Example (assuming **ECHO** is **ON**):

RH? Get RH.
1.9872463E+01 Returns 19.87% RH for this example. The 8 digit output resolution is merely a mathematical convention and is not indicative of increased measurement accuracy.

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.  
. .  
100 OUTPUT 705; "RH?; DRYT?; DP?" 'Get % RH, Temp, DP.  
110 ENTER 705; Rh, Tmp, Dp  
120 PRINT "RH", "TEMP", "DP" 'Display column headings.  
130 PRINT Rh, Tmp, Dp 'Display values.  
. .  
.
```

SAVE

SAVE = *password* saves calibration coefficients, printer configuration, and the pressure to non-volatile memory, overwriting any existing values. The temperature calibration coefficients only affect the active probe (see **PROBe** command). The *password*, 5A1MP, is required in order to prevent accidental alteration of non-volatile memory.

IBM BASICA Example (assuming COM1 initialized to #1 and 5A-1MP **ECHO** is OFF):

```
.  
. .  
100 PRINT #1, "PROB=1"           'Set Probe 1  
110 PRINT #1, "DZERO?"          'Get dry bulb zero  
120 INPUT #1, A                  'Coefficient  
130 PRINT #1, "DZER=";A + 0.25   'Offset dry bulb by .25•C  
140 PRINT #1, "SAVE-5A1MP:"      'SAVE to non-volatile memory  
. .  
. .
```

TERMINAL Example (assuming **ECHO** is ON):

```
PRES = 24.50           Set to 24.50 "Hg  
SAVE = 5A1MP          Save to non-volatile memory
```

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.  
. .  
100 OUTPUT 705; "DOZE=401.640;  
    DOSP=.33323116"           !Change Ohms coefficients.  
110 OUTPUT 705; "DOLI=.000082441619;  
    SAVE=5A1MP:"             !Save them.
```

RELATED COMMANDS:

REStore
PROBe

AFFECTED COMMANDS:

DOZEro
DOSPan
DOLnearity
WOZEro
WOSPan
WOLnearity
DZERo
DSPan
DLnearity
WZERo
WSPan
WLnearity
HEADer
FORMfeeds
ENDLine
LINEs
PRESsure

TIME

TIME=*hh:mm:ss* sets the real time clock in the 5A-1MP. The time is entered in hours (*hh*), minutes (*mm*), and seconds (*ss*), with each separated by a delimiter (. , : - or /). **TIME=** is compatible with the Time\$ function of IBM BASICA and HP Rocky Mountain BASIC. Note that seconds are optional and will default to:00 if not specified.

TIME? returns the time in *hh:mm:ss* format.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.
.
.
100 PRINT #1, "TIME="; TIME$           'Synchronize to IBM clock.
.
.
.
200 PRINT #1, "TIME?"                 'Get time.
210 INPUT #1, A$
220 PRINT "5A-1MP TIME IS "; A$       'Display on monitor.
.
.
.
```

TERMINAL Example (assuming **ECHO** is **ON**):

```
TIME?           Get time.
16:15:21         It's 4:15 p.m.
TIME=8:11       Set to 08:11:00.
TIME?
08:11:04         Took me 4 seconds to type TIME?
```

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.
.
.
100 OUTPUT 705; "TIME="; TIME$(TIMEDATE) !Sync to HP.
.
.
.
300 OUTPUT 705; "TIME?"                 !Get 5A-1MP time.
310 ENTER 705; T$
320 DISP "5A-1MP TIME IS "; T$         !Display time.
.
.
```

RELATED COMMANDS:

DATE

WETOhms (Wet Ohms)

WETO? is used only during factory calibration, and returns the measured resistance of the Wet Bulb in ohms. All ohms values are returned in 8 digit scientific notation. Values should be between 440 and 690 Ω .

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.  
. .  
100 PRINT #1, "WETO?"           'Request value.  
110 INPUT #1, A$               'Read it in.  
120 DRY.OHMS=VAL (A$)         'Make it numeric.  
. .  
. .  
. .
```

TERMINAL Example (assuming **ECHO** is **ON**):

```
WETOhms?                       Request value.  
6.7844999E+02                   678.44999  $\Omega$  for this example.
```

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
. .  
200 OUTPUT 705; "WETOHMS?"     !Get value.  
210 ENTER 705; R2  
220 DISP R2; "ohms"           !Display Ohms.
```

WETSvp

(Wet Bulb Saturation Vapor Pressure)

WETS?

returns the current Saturation Vapor Pressure at the Wet Bulb temperature, in inches of mercury. All saturation vapor pressures are returned in inches of mercury in 8 digit scientific notation.

IBM BASICA Example (Refer to **DPSV** command).

TERMINAL Example (Refer to **DPSV** command).

IEEE 488 Example (Refer to **DPSV** command)

WETTemp (Wet Bulb Temperature)

WETT? returns the current Wet Bulb temperature. All temperatures are returned in degrees centigrade, in 8 digit scientific notation.

IBM BASICA Example (Refer to **DP** command).

TERMINAL Example (Refer to **DP** command).

IEEE 488 Example (Refer to **DP** command).

WLINEarity (Wet Bulb Linearity Coefficient)

WLIN=*number* is used during factory calibration only, and temporarily changes the LINEARITY coefficient of the Wet Bulb temperature formula. The *number* stored is valid only until power is removed, the **RESET=C** command is issued, the probe number is changed from the keypad, or the **PROB=*n*** command is used. The number is entered in either standard or scientific notation. The power-up default value is determined during factory calibration and stored in non-volatile memory. Refer to the **RESTore** and **SAVE** commands to alter non-volatile memory.

WLIN? returns the LINEARITY coefficient of the Wet Bulb temperature formula of the currently selected probe.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.
.
.
100 PRINT #1, "WLIN?"           'Read current value.
110 INPUT #1, A$
120 OLD.NUM=VAL(A$)             'Convert to numeric.
.
.
.
200 NEW.NUM=FN...               'Calculate a new coefficient.
210 PRINT #1, "WLIN="; NEW.NUM  'Send new coefficient to 5A-1MP.
.
.
.
```

TERMINAL Example (assuming **ECHO** is **ON**):

```
WLIN?
8.2440000E-05           Power-up default of uncalibrated unit.
WLINEARITY=.000087654321 Send new coefficient, standard notation.
WLIN?
8.7654321E-05           Verify.
WLIN=.8877665e-4?     Send and verify in same step.
8.8776650E-05
```

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.
.
.
```

```
100  OUTPUT 705; "WLINEARITY?"           !Get value.
110  ENTER 705; x
.
.
.
600  L = .000087654321                   !Change value.
610  OUTPUT 705; "WLIN="; L
.
.
.
```

RELATED COMMANDS:

WSPAn
WZERo
PROBe
RESTore
SAVE

WOLInearity (Wet Ohms Linearity Coefficient)

WOLI=number is used during factory calibration only, and temporarily changes the LINEARITY coefficient of the Wet Bulb ohms formula. The *number* stored is valid only until power is removed, the **RESET=C** command is used, or a cold reset is executed from the keypad. The *number* is entered in either standard or scientific notation. The power-up default value is determined during factory calibration and stored in non-volatile memory. Refer to the **REStore** and **SAVE** commands to alter non-volatile memory.

WOLI? returns the LINEARITY coefficient of the Wet Bulb ohms formula.

IBM BASICA Example (assuming com1 is initialized to #1 and 5A-1MP **ECHO** is **OFF**):

```
.  
. .  
100 PRINT #1, "WOLI?"           'Read current value.  
110 INPUT #1, A$  
120 OLD.OHM.LIN=VAL (A$)  
. .  
200 PRINT #1, "WOLI=7.7827037E-5?" 'Send and request in same line.  
210 INPUT #1, A$  
220 PRINT VAL (A$)             'Displays .000077827037.
```

TERMINAL Example (assuming **ECHO** is **ON**):

```
WOLI?  
0.0000000E+00           Power-up default of uncalibrated unit.  
WOLI=.079182456E-3    Change value.  
WOLI?                Read it back.  
7.9182456E-03
```

IEEE 488 Example (HP Rocky Mountain BASIC syntax):

```
.  
. .  
100 OUTPUT 705; "WOLI = .000077827037" 'Change it.  
. .  
300 OUTPUT 705; "WOLIN?"             'Read it.
```

310 ENTER 705; W3

RELATED COMMANDS:

WOSPan
WOZEro
RESTore
SAVE

WOSPan (Wet Ohms Span Coefficient)

WOSP=number is used during factory calibration only, and temporarily changes the SPAN coefficient of the Wet Bulb ohms formula. (Refer to **WOLI** command).

WOSP? returns the SPAN coefficient of the Wet Bulb ohms formula.

IBM BASICA Example (Refer to **WOLI** command).

TERMINAL Example (Refer to **WOLI** command).

IEEE 488 Example (Refer to **WOLI** command).

RELATED COMMANDS:

WOLInearity

WOZEro

RESTore

SAVE

WOZEro (Wet Ohms Zero Coefficient)

WOZE=number is used during factory calibration only, and temporarily changes the ZERO coefficient of the Wet Bulb ohms formula. (Refer to **WOLI** command).

WOZE? returns the ZERO coefficient of the Wet Bulb ohms formula.

IBM BASICA Example (Refer to **WOLI** command).

TERMINAL Example (Refer to **WOLI** command).

IEEE 488 Example (Refer to **WOLI** command).

RELATED COMMANDS:

WOLInearity
WOSPan
RESTore
SAVE

WSPAn

(Wet Bulb Span Coefficient)

WSPA=*number*

is used during factory calibration, and temporarily changes the SPAN coefficient of the Wet Bulb temperature formula. The *number* stored is valid until power is removed, the **RESET=C** command is used, the **PROB=*n*** command is used, the probe number is set or changed from the keypad, or a cold reset is executed from the keypad. The power-up default value is determined during factory calibration and stored in non-volatile memory. Refer to **RESTore** and **SAVE** commands to alter non-volatile memory.

WSPA?

returns the SPAN coefficient of the Wet Bulb temperature formula of the currently selected probe.

IBM BASICA Example (Refer to **WLIN** command).

TERMINAL Example (Refer to **WLIN** command).

IEEE 488 Example (Refer to **WLIN** command).

RELATED COMMANDS:

WLINearity
WZERo
PROBe
RESTore
SAVE

WZERO

(Wet Bulb Zero Coefficient)

WZER=number

is used during factory calibration, and temporarily changes the ZERO coefficient of the Wet Bulb temperature formula. The *number* stored is valid until power is removed, the **RESET=C** command is used, the **PROB=n** command is used, the probe number is set or changed from the keypad, or a cold reset is executed from the keypad. The power-up default value is determined during factory calibration and stored in non-volatile memory. Refer to **RESTore** and **SAVE** commands to alter non-volatile memory.

WZER?

returns the ZERO coefficient of the Wet Bulb temperature formula of the currently selected probe.

IBM BASICA Example (Refer to **WLIN** command).

TERMINAL Example (Refer to **WLIN** command).

IEEE 488 Example (Refer to **WLIN** command).

RELATED COMMANDS:

WLINearity
WSPAn
PROBe
SAVE

CABLING SPECIFICATIONS AND PINOUTS

8.1 DB25 PRINTER AND RS-232 CONNECTOR

The connection for the RS-232 communications port and the Centronics parallel printer port are combined into a single DB25 connector on the 5A-1MP instrument panel. Although this connector has the appearance of a standard RS-232C receptacle, it is not wired in an RS-232 format.

The following diagram shows the electrical connections for the cables needed to connect the 5A-1MP to a printer and/or an RS-232 interface of a computer terminal.

Centronics Parallel Printer Cable Connections

<u>5A-1MP (DB25)</u>	<u>DIRECTION</u>	<u>PRINTER (CENTRONICS)</u>	<u>FUNCTION</u>
1	—>	1	STROBE*
2	—>	2	D0
3	—>	3	D1
4	—>	4	D2
5	—>	5	D3
6	—>	6	D4
7	—>	7	D5
8	—>	8	D6
9	—>	9	D7
11	<—	11	BUSY
14-24	—	19-29	GND

RS-232 Serial I/O Cable Connections

<u>5A-1MP (DB25)</u>	<u>DIRECTION</u>	<u>COMPUTER/ TERMINAL</u>		<u>FUNCTION</u>
		DB25	DB9	
12	<—	2	3	5A1MP INPUT
13	—>	3	2	5A1MP OUTPUT
25	—	7	5	SIG GND

*Indicates active low signal level.

8.2 IEEE 488 CONNECTOR

The IEEE 488 interface uses a standard IEEE 488 cable to connect the 5A-1MP to a computer. The following is a list of the connector pins and their functions.

<u>IEEE 488 CONNECTOR</u>	<u>FUNCTION</u>
1	DIO1
2	DIO2
3	DIO3
4	DIO4
5	EOI
6	DAV
7	NRFD
8	NDAC
9	IFC
10	SRQ
11	ATN
12	SHIELD
13	DIO5
14	DIO6
15	DIO7
16	DIO8
17	REN
18-24	GND