Release C, March 15, 2000

# Technical Data and Instructions

## Thermograph II

These operating instructions apply to the Thermograph instrument developed by B-G Instruments, Inc. The operating functions described herein are based on revision I of the Functional Specification THRM- .0, .1, .2.

## General Description

The thermograph accepts up to 2 analog inputs, displays the values numerically and plots them against time on a paper strip recording. The inputs may be direct analog voltages or from thermistor probes. In the latter case, the thermistor signals are measured, linearized and reported in degrees F or C. Figures 1 and 2 show front and rear views of the instrument. A typical dual channel recording is shown in figure 4. Overall dimensions are 11" wide x 9" deep x 8" High. The instrument weighs approximately 12.5 lbs. with probes, power cord and paper roll installed.


**Figure 1, Front Panel**

## Temperature Probe Inputs

YSI type 400 thermistor probes, fitted with standard phone plugs, may be connected to the marked input jacks on the rear panel. The instrument senses when such Phone plugs are inserted and automatically applies bridge balance sensing and digital linearization to that channel, and displays the result as a temperature. The standard temperature range is 40 to 80°F, with +/- .01 °F precision. Optional alternate ranges (available on special order from B-G are 55 to 95°F and 30 to 150°F.) The latter range displays a precision of +/- .03° F


**Figure 2, Back Panel**

## Voltage Inputs

If no temperature probe is plugged into a channel, that channel will be displayed as a voltage input, over the range from -10.00 to + 10.00 volts. The voltage source must have an impedance less than 100 ohms and be connected to the corresponding BNC receptacle on the rear panel. One channel may be used for temperature while the other is used for voltage if desired. The input connections must be made before power is turned on, since the program checks for plug status only at that time. If a temperature probe is inserted or removed after power-up, the input signal will be incorrectly interpreted and the displayed and recorded values for that channel will be meaningless.

## Paper Loading

Use type TP-3 thermal paper, available from B-G instruments. If other sources must be used, be certain the thermal paper is facsimile grade, 2.6 inches (66mm) wide with a roll diameter not greater than 2 inches, the sensitive side outward and the paper not adhered to the core.

If the instrument power is on, the "autoload" feature makes paper loading particularly easy. First, unlatch and swing open the printer access door to reveal the paper supply tray. Remove any adhesive sticker from the paper roll end and place the roll into the supply tray, as shown in figure 3. Pull out a few inches of paper and insert the roll end as shown, pushing it down into the printhead area. A sensor will detect the paper end, activate the platen and pull the paper through the mechanism until it extends about an inch beyond the front panel. The printer is now ready for use, merely close and latch the access door.

Paper may also be loaded without power by manually raising the printhead lifter while inserting the paper from the rear. After the paper end clears the front panel, pull it forward an inch or so and center it while continuing to lift the printhead lifter.

The last meter of paper is marked with a red stripe so that you will be able to estimate when paper will run out. The printer will stop when it detects the paper end in the vicinity of the printhead.

## Paper Advance

A front panel switch causes the paper to advance without printing, as for tearing off a record without losing any plotted data. If the paper-out sensor detects an out-of-paper condition, the paper advance function (and, indeed, the normal printing function) is disabled.

## Recording Speed

The normal recording speed plots 24 hours on approximately 28 inches of paper, so that a single 80 foot roll of paper can record continuously for more than a month. The fast recording speed is about 9 times faster than the normal speed and is particularly useful when setting up the recording parameters without having to wait long to verify the results on the paper record. In the fast mode, the display is also updated more frequently and therefore blinks more noticeably. In the fast mode, however, the thermograph will consume about 21 feet of paper per day, and a roll will last only about 4 days. Speed is selected by front-panel switch.

## High/Low Alarms

This front panel switch activates the audible high and low measurement alarms. By default, these are set at the measurement range limits, normally 40°F and 80°F (or -10 and + 10 volts), settings that may be changed as described below. When the measured value is outside the alarm limits, a high pitched audible alarm sounds and continues to sound until the measurement returns to within tolerance or the alarm switch is turned off. Adjust the loudness by rotating the cover of the Sonalert device located on the rear panel. When both alarm limits are set at the range limits, the alarm function is disabled.

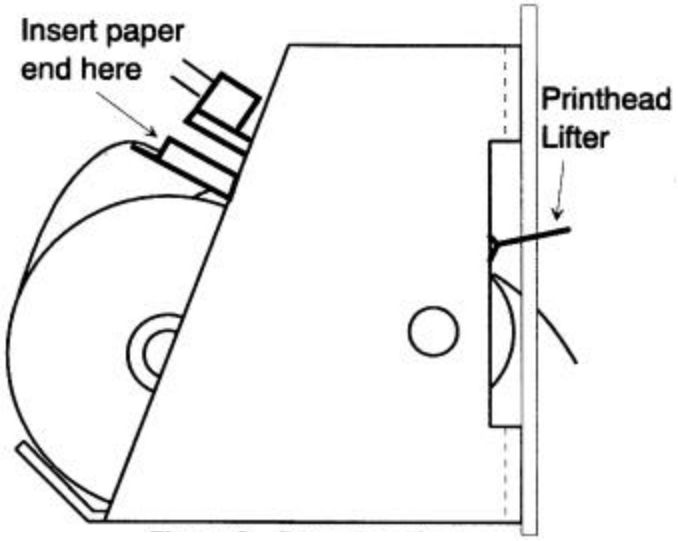


**Figure 3, Paper Loading**

## Number of Plotted Channels

A front panel switch allows the operator to choose plotting both channels or just channel 1. If both channels are plotted, each plot region is one inch wide with 1 % plotting resolution and the two plots are separated by a space in which the time of day is noted hourly. If only channel 1 is plotted, the plotting width for that channel is increased to two inches. This control has no effect on the visual display, which always shows two channels.

## Volts or Microinches

This front panel switch has no effect on temperature measurements. If no temperature probe is inserted, however, the input voltage is measured directly, and this switch determines whether the display and printout is labeled "V" or "M" . It has no other effect.

## Time and Date

The plotted paper record includes time and date notations. At midnight, 06:00, noon and 18:00, the plot is briefly interrupted to print information about the range of each plot area, the date, the time and the alarm limits, if any. This information is also printed when either channel setup is changed and when the time and/or date is reset. In addition, the hour number is printed each hour beside the plotting area, and grid lines are printed every quarter hour. The time and date are maintained by a battery backed clock/calendar chip. through extended periods of power-off, so they do not often need to be set. To set the time and date, press the key labeled DTE; the display will prompt for the time. Enter a new time by pressing 4 numeric keys in the format hhmm, such as " 1755" for 5:55 pm, followed by the ENT key. Press only ENT to retain the old time setting. The display will then prompt for the date. Press 6 keys in the format MMDDYY followed by the ENT key, or ENT alone to retain the old date. Remember to enter the leading zero when one is required.

## Setting the Plot and Alarm Parameters

The plot span, center value, low alarm level and high alarm level are set for each channel by the following procedure:

| **Your action** | **Instrument response** |
|---|---|
| Press Set key | Prompts for channel # |
| Press 1 or 2 | Prompts for span |
| Press .5, 1, 2, 4, 8, 10, 12 or 20, then ENT* | Prompts for center value |
| Press 4 digits, then ENT* | Prompts for low alarm level |
| " " | Prompts for high alarm level |
| " " | Prints setup, resumes display |

* Or just press ENT to retain the previous value

All the temperature responses require entering 4 digits because there is an optional temperature range that runs up to 150 ° F and the values are set to .01 °F precision. You must, for example, enter 68.0°F as 0680. Remember too, that the instrument will not accept a center value that would cause part of the plot area to fall outside the overall range. For example, with a span of 20°F, you cannot set the center point higher than 70.0°F, because the top of the plotting range would then lie above 80.0°F, which it may not do in a standard 40.0 to 80.0°F thermograph. The upper alarm limit may not be set below the lower alarm limit, and neither alarm may be outside the range.

Note that using the above procedure twice to set up both channels results in two setup reports being printed, with only the second one reporting both channels correctly. If you prefer, you could set up both channels at the same time and print just a single report by using the following sequence:

| **Your action** | **Instrument response** |
|---|---|
| Press Set key | Prompts for first channel # |
| Press 1 | Prompts for span |
| Press Set key again | Prompts for second channel # |
| Press 2 | Prompts for span 2 |
| Press .5, 1, 2, 4, 6, 8, 10, 12 or 20, then ENT* | Prompts for center value 2 |
| Press 4 digits, then ENT* | Prompts for low alarm level 2 |
| " " | Prompts for high alarm level 2 |
| " " | Prompts for span 1 |
| Press .5, 1, 2, 4, 6, 8, 10, 12 or 20, then ENT* | Prompts for center value 1 |
| Press 4 digits, then ENT* | Prompts for low alarm level 1 |
| " " | Prompts for high alarm level 1 |
| " " | Prints report, resumes display |

* Or just press ENT to retain the previous value

## Voltage Plot Setup

If you are plotting voltage, the setup procedure is just as described above except that "Degrees F" or "Degrees C" is replaced by "volts". The permitted span values are 1, 2, 4, 10 and 20 volts and the center and alarm values are set by entering 4 digits, as xx.xx volts. Precede negative voltage entries with the "-" key.

## Temperature Scale Choice

A front panel switch permits the operator to choose between Fahrenheit and Celsius temperature scales. These choice applies to the visual display, to the printed record and to the printer and alarm point setup parameters. To simplify the discussion in this document, I will assume that the selected scale is Fahrenheit. Operating with a Celsius display is similar, although the acceptable numerical ranges will be different and will not be round numbers.

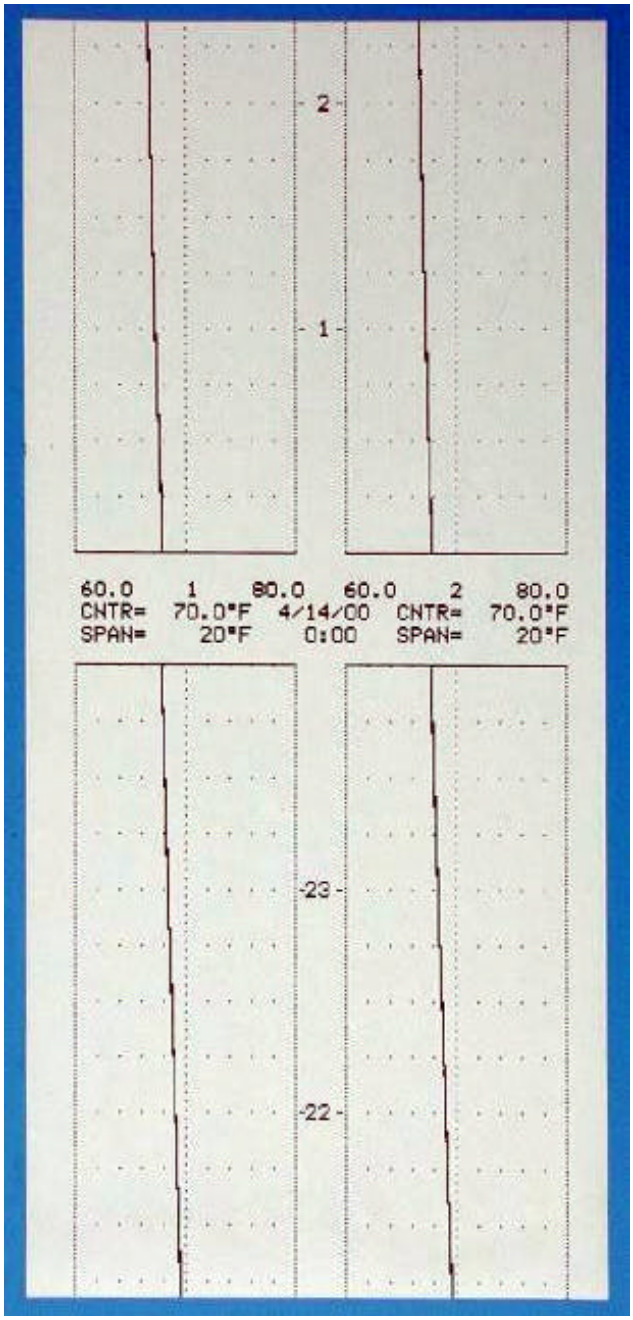


**Figure 4**
**A Typical 2-Channel Temperature Plot With a Setup Report.**

## Serial Data I/O

A 25-pin "D" connector on the rear panel serves a bi-directional RS232C serial port, configured for 1200 baud, 8 data bits, no parity, one stop bit. The XON/XOFF protocol is used. This interface is used primarily to send out to a host computer all the data shown on the thermograph's front panel display and to permit control of the thermograph's keypad by that host computer.

Upon power-up, the character DC 1 ($11) is sent out and the lines RTS and DTR are set high. The CTS line must be held high in order for the hardware transmitter to output data. The DSR line is not used. There is a 96 byte FIFO buffer into which all received characters are placed and from which characters are taken and processed continuously. When fewer than 32 positions are left in the FIFO, the character DC3 ($13) is sent out on the serial interface and the lines RTS and DTR are forced low. The host computer should stop sending data. When the FIFO is emptied to the point where there is room for 64 or more characters, the character DC 1 is sent out and the lines RTS and DTR are again set high. The host computer may then send more data.

## Serial Command Input

Each key on the keypad may be `pushed' remotely via the serial interface by sending the appropriate character. For the leftmost 3 columns, that character is just the label on the key. For the keys in the rightmost column, send `C' for CLR, `A' for SET, `B' for DTE and `E' for ENT. For example, to set the time and date to 9:45 am on June 3, 1992, you would send the sequence:

B0945E060392E

If channel 1 is set to monitor voltage and channel 2 is set to monitor temperature in Fahrenheit, the following sequence would set channel 1 span to 10 volts, center to +5.0 volts and leave both alarm levels as previously set:

A 110E050EEE

The following sequence would set channel 2 span to 4°F, center to 70.0 °F and set the alarm limits at the plotting limits:

A24E0700E0680E0720E

After each of these sequences, a report will be printed with the new setup values. If you want only a single report printed to cover both channel setups, you can combine the two setup sequences into one as follows:

AIA24EO700EO680EO72OE10EO50EEE

## Serial Data Output

Whenever the display is updated, whether from normal data sampling, keypad entries or remote control keypad entries, the data on the display is sent out on the serial interface. The format is exactly what is displayed, with the addition of the character `&' to signal the start of the line and the character `cr' ($0D) to signal the end. The host computer may use the `&' character for synchronization. A total of 22 characters is sent to each such line except as shown below.

There is a special command code that the host computer may send in order to cause the current time, data and channel setup parameters to be returned over the serial interface. This command is the single character `@'. The data sent in response to this command is five lines in the following format:

| | |
|---|---|
| @ &hh:mmDD/MM/YYI | (current time and date) |
| &SS^FbCCC.C^FI | (channel 1 span & center temperature) |
| &sLLL.L^FsUUU.U^FI | (channel 1 lower & upper alarm limits) |
| &SSVbsCC.CVI | (channel 2 span & center voltage) |
| &bsLL.LVbbsUU.UVI | (channel 2 lower & upper alarm limits) |

where:
- I is the ‘cr’ character
- b is the blank character
- F is either F or C
- V is either V or M
- s is either blank or ‘-’
- SS is the span setting
- CCC.C is the center setting
- LLL.L is the lower alarm limit
- UUU.U is the upper alarm limit

## Non-Volatile Data Storage

The system time and date are kept current by the battery-backed clock/calendar circuit, even during extended power-out periods. In addition, all of the plot and alarm parameters for both channels are kept in non-volatile memory and will be in effect when the thermograph power is restored.

## Thermal Paper

We recommend using B-G Instruments' type TP-3 thermal paper, or its equivalent, in the thermograph. This paper produces a black on white image that is stable with time. Unlike some waxy coated papers, it does not stick to or cause material build-up on the printhead. TP-3 is a 2.6 inch wide, high quality facsimile grade paper that can produce high resolution permanent copy in the PM 1224 printer. h is available from B-G Instruments in cartons of 36 rolls, or in larger quantities.

## Power

The thermograph comes with a standard U.S. line cord for connecting 110 Vac power to the recessed plug on the rear panel. Instruments may also be specially ordered for use with various foreign power sources. With the instrument's power switch (front panel, lower left) off, connect the power cord, then turn on the power switch, which will illuminate red. If it does not, check the fuse located on the rear panel.

Upon powering-up, the thermograph will display a line identifying itself and its version number, such as ' B-G THERMOGRAPH . IO'. Here, the letter I identifies revision I of the program and the '0' identifies the temperature range as 40 to 80°F. (' 1' would mean 55 to 95 °F and '2' would mean 30 to 150°F) The thermograph will then begin displaying the measured values for channel 1 to the left and channel 2 to the right. If the printer switch is on, the measured values will also be plotted as a graphical record on paper. Since the normal (slow) paper speed is only about one inch per hour, you may have to wait several minutes to see any recorded data.

## Warranty

B-G Instruments will repair or replace, at its option any thermograph that malfunctions because of faulty manufacture within one year after its original date of sale, provided that the mechanism has been used exclusively with B-G Instruments' type TP-3 thermal paper, and:

1. neither the print mechanism nor its control board have been modified in any way not specially authorized by B-G Instruments, Inc., and
2. electrical power applied to the thermograph has always been within specifications, and
3. the thermograph shows no evidence of electrical, thermal or mechanical damage, and
4. the mechanism has printed fewer than 100 million dot rows and less than 100 thousand feet of paper.

**B-G Instruments, Inc.**
**13607 E. Trent Ave.**
**Spokane Valley, WA 99216, U.S.A.**
www.bginstruments.com

**Toll Free: (888) 244-4004**
**Phone: (509) 893-9881**
**Fax: (509) 893-9803**
**Email:** contact@bginstruments.com