WARRANTY

With the exception of the printhead, EPC Labs, Inc. warrants the GSP-1086 Thermal Gray Scale printer to be free of any defects and in good working order for a period of one year from date of delivery. The printhead is warranted for a period of 90 days after delivery. In the event of failure of any part(s) due to defect in material or workmanship occurring within the warranty period, EPC will repair or replace the product at no charge for parts and labor performed at a company designated repair facility.

EPC will not be obligated to, or liable for, repair or replacement of the product due to the misuse, abuse, misapplication, or the modification of the product without prior written consent from EPC Labs. This includes the use of unauthorized recording medium (thermal film and/or paper) which may cause irreparable damage to the printhead as well as the entire recorder. In addition, EPC will not be liable for damages, lost revenue, lost wages, lost savings, or any other consequential or incidental damages arising from same.

The user of this product will be responsible for packing and shipping the failed product properly, and for the shipping charges associated with the return of the product to an EPC repair facility. EPC will be responsible for returning the product to the place of origin, and all associated costs.

EPC laboratories, Inc.

CHAPTER ONE
INTRODUCTION

1.0 GENERAL

The EPC model 1086 gray scale printer, hereinafter referred to as the 'GSP', is a rugged, self contained line scan recorder. Utilizing thermal printing technology, the GSP can produce near photographic quality images on heat sensitive paper or film. The definition with which the images are printed is selectable up to 256 levels of gray*. The output media is continuous, wound on an internal take-up spool. Each line of printed data is comprised of 2048 pixels (picture elements) spaced at 203 dots per inch (8 dots/mm). This provides an active print width of 10.09 inches. Interfaces for the GSP vary depending on the operator's needs. Detailed specifications for the different configurations can be found in the appendices to this manual.

1.1 FEATURES

With the GSP-1086, EPC Labs has provided a host of new features not found in its other recorders. These features have been added to improve print quality, facilitate maintenance actions, and provide an easy means for low-cost upgrades in the future. A list of some of these new enhancements follows:

* **SERIAL UPGRADE LINK -** In the past, if an operator needed to update the internal software of an EPC recorder, he or she would have to open the machine up and install a new EPROM. Now, because the GSP's embedded code is stored in flash memory, the program can be updated via the RS-232 interface. An operator need only attach his or her PC, via a serial cable and null modem, to the serial port and run the upgrade utility program. In a matter of seconds the necessary upgrade is made and the machine can be re-booted to enable the new code.

* **EXPANDABLE ISA BUS** - The GSP-1086 uses the ‘industry standard architecture' found in many personal computers. This allows the machine to be configured and upgraded by simply plugging new boards into the free expansion slots in the passive backplane.

* **KEYBOARD INTERFACE -** To gain greater flexibility in the function of the recorder, EPC Labs has provided an interface for a standard 'qwerty' type keyboard. Using the keyboard, an operator can enter annotation and send remote commands to the unit.

* **SOFTWARE DEFINED CONTROL PANEL –** The control panel on the GSP-1086 is totally defined in software. This allows EPC Labs to tailor the controls to the specific needs of each user. The basic set of functions provided with the GSP are very comprehensive. If, however, the need arises for a very specific function, EPC can most likely roll it into the internal code without much trouble.

* **CONFIGURATION FILES -** EPC realizes that the equipment is often used in different capacities with different configurations. For this reason, the GSP offers four different 'config' files. An operator can choose any one of these setup files to hold the systems power-on defaults. After the recorder is set to suit an operator's needs, pressing the 'save' button will write the current settings to the named file in flash memory.

1.2 ARCHITECTURE

The general layout of the GSP's electronics is referred to as its architecture. The following paragraphs describe the various components responsible for making up this architecture.

1.2.1 ISA COMPONENTS

As mentioned previously, the GSP-1086 makes use of an ISA bus architecture, similar to the one found in most personal computers. Instead of using a motherboard with the CPU installed on it, the GSP uses a passive backplane for bus operations. The actual CPU resides on a single board computer that plugs into the backplane. In addition to running the system code, the CPU board also provides the RS-232, RS-422, and keyboard interfaces.

Two other circuit boards on the bus are common to all GSP configurations. The digital I/O board is used to monitor all switches and sensors. Other of its I/O lines are used to drive the LCD displays. Several unused bits of I/O are reserved for future use. The ISA control board is the workhorse of the system. This three-quarter size card is responsible for loading data into, strobing, and sensing the temperature of the printhead. Depending on how the GSP is configured, it will also have one or more types of interface boards installed on the bus. Refer to the appendix for information regarding specific interfaces.

1.2.2 CHART DRIVE COMPONENTS

The paper transport mechanism is comprised of several components. Visible to the operator are the pinch roller and urethane drive roller located on the right hand side of the unit. The drive roller is advanced through a gear train that ultimately connects to a rugged, high-speed, stepper motor. The electronics that control the stepper are found on the chart module. The chart module can be identified by the large black heat sink mounted to it. This component is mounted underneath the control panel and is connected to both the chart motor and the large green motor drive PC board. The motor drive PC actually has several different functions which are described in detail later in this chapter. Primarily, the motor drive board uses a programmable oscillator in conjunction with programmable array logic (pal) to clock the chart module.

1.2.3 CONTROL PANEL

In stand-alone applications, most of the GSP's available functions can be implemented through the control panel, at the top of the machine. Thirty-two different membrane switches provide user input while the two LCD displays feedback information about the recorder. The LCD’s are 2 lines x 40 characters wide. On the left LCD, less frequently changed settings are displayed; the right LCD shows the settings that tend to change frequently (contrast, LPI, etc.). Along the top of the panel is a row of permanent switches, the function of which are configurations (system reset, take-up enable, common to all rapid advance, etc.). The functions of the remaining switches depend on whatever is displayed on the to LCD’s at a given time.

1.2.4 MOTOR DRIVE PC

Mentioned previously, the primary function of the motor drive PC is to clock the stepper module for paper advance. The board also performs a variety of other tasks. The motor drive PC serves as a patch board between the digital I/O board and various GSP components. Several I/O lines are used to enable the take-up motor, drive the LCD’s, sense error conditions and control the chart drive timing. Two trim-pots mounted to the reverse side of the board control the viewing angle adjustment to the LCD’s. The trim pots are accessible from inside the electronics chamber. The motor drive PC board is also where the printhead power relay is mounted. The power relay gates the 24 volt power supply to the printhead. It is controlled by an I/O line so that power is only being provided when the 1086 is printing.

1.2.5 POWER SUPPLY

All system power is distributed by a single AC to DC power supply. The supply has an input range of 90-265 VAC. A quad output delivers +5, +12, -12, and +24 volts, DC. The adjustable outputs are factory set and should not be changed.

1.2.6 PRINTHEAD

The thermal printhead is located in the paper feed magazine. The head consists of 2048 resistive heaters spaced at 203 dots per inch (8 dots/mm). To dissipate the heat that builds up on the printhead, the component is mounted to a heavy aluminum plate. An analog to digital converter on the ISA controller reads and coverts temperature information from the printhead's internal thermistor. That information is used to adjust the output for different temperature gradients. It also senses an overheat condition to shut the printer down. Print voltage is derived from the 24 Volt output on the power supply.

1.2.7 INTERFACE PANEL

The interface panel is located just below the viewing area. Inter-connections available will depend on the configuration ordered. There are two basic styles of panels -- a "digital only" panel, and an "analog/digital" panel. Both panels provide connections to the following interfaces:

* RS-232 serial I/O (9 pin sub-d)

* High speed parallel I/O (25 pin sub-d)

* Qwerty keyboard I/O (5 pin din jack)

* Composite ban video ('RCA' phono jack)

* S-Video (4 pin min-din jack)

If a non-video configuration was ordered, the video cables will not be connected to anything inside the machine. They are available for future upgrade. Analog type recorders will provide BNC connections for printing analog data. The "digital only" machines will have additional access for parallel output and RS-422 input with no BNCs.

General specifications for the GSP-1086 can be found on the following page.

TABLE 1-1 GENERAL SPECIFICATIONS

POWER	AUTO-SENSE 90-264 VAC
WEIGHT	40 POUNDS WITH PAPER
WEIGHT W/ XPORT CASE	75POUNDS
DIMENSIONS	17.25" W x 19.25" H x 6.5"D
OPERATING TEMPERATURE	0 C TO 65 C (NON-CONDENSING)
STORAGE TEMPERATURE	-28 C TO 65 C (NON-CONDENSING)
PAPER LENGTH	150 FEET
FILM LENGTH	120 FEET
PAPER/FILM WIDTH	10.48 INCHES
RESOLUTION	203 DOTS PER INCH
DATA POINTS	2048
TONE SHADES*	8,16, 32, 64
WARRANTY	LIMITED ONE YEAR, PARTS AND LABOR

* MAY VARY DEPENDING ON CONFIGURATION

CHAPTER TWO
INSTALLATION

2.0 INVENTORY

After unpacking the recorder from the container that it was shipped in, a quick inventory should be taken. Included in the shipment should be the following items:

* **THE RECORDER** – it will be very obvious if this one is missing.

* **THE LINE CORD -** This is the cord that connects the recorder to the AC power source.

* **THE OPERATOR'S MANUAL -** This is the manual you are reading right now. If special options were ordered with the GSP, there may be a supplemental manual in addition to the base operator's manual.

* **ONE ROLL OF THERMAL FILM -** High grade thermal film is shipped with the unit. Lower cost thermal paper is also available, contact EPC Labs for details.

* **SPARE PARTS KIT -** If spare parts were ordered, verify the contents of the spare parts package.

2.1 SITE PREPARATION

The GSP-1086 should be set up in a clean, dry location. The site chosen should be free of dirt, debris or other contaminants. A suitable AC line source should be located nearby. Provisions should also be made to store any printed records in a cool, dry area, away from ultra-violet light.

2.2 MOUNTING

Two different mounting configurations are possible with the unit; stand-alone and rack mount. As a stand-alone recorder, the GSP can be set flat or standing upright on the side of its sheet metal case. During setup, the unit should be set on a stable surface with ample space. If the printer is to be mounted in an industry standard, 19 inch equipment rack, the mounting flanges should be secured to the rack using eight (8) 10-32 bolts with large pattern washers.

2.3 POWER

An AC (alternating current) line source is required to run the GSP. The line cord provided with unit is designed to interface with standard U.S. electrical outlets. The acceptable input source for the recorder is 90-264 VAC, 47-63Hz. There is no need to flip any special switches or change any fuses when switching from 115 VAC to 220 VAC. The power supply automatically adjusts for different sources. **FAILURE TO ADHERE TO THE LINE INPUT SPECIFICATIONS MAY RESULT IN SEVERE DAMAGE TO THE UNIT AND/OR BODILY HARM TO THE OPERATOR. NEVER PERFORM ANY MAINTENANCE WITHOUT UNPLUGGING THE UNIT FROM ITS A.C. SOURCE FIRST.**

2.4 INTERFACE CONNECTIONS

The standard interfaces on the GSP-1086 are RS-232, RS-422, qwerty type keyboard, and parallel digital. The mating connectors required to connect to these interfaces are as follows:

* RS-232 - 9 SOCKET SUB'D'

* RS-422 - 9 SOCKET SUB'D'

* KEYBOARD - 5 PIN CIRCULAR DIN CONNECTOR, STANDARD 101 TYPE KEYBOARDS

* PARALLEL - 25 SOCKET SUB'D'

The primary data interface varies between different versions of theGSP-1086. Refer to **APPENDIX A - *GSP-1086 INTERFACE SPECIFICATIONS*** for detailed information on all the interfaces installed in the unit.

2.5 LOADING PAPER

Before the GSP is ready for operation, paper must be properly loaded in the paper feed chamber, and threaded through the chart drive mechanism. This is accomplished by the following steps (refer to fig 2-1):

OPEN THE PRINT ROLLER ASSEMBLY:

While lifting up on the two retractable plungers, slide the roller latches fully back towards the right of the GSP. Note that the plungers have knurled grips. Do not turn them, they should be lifted. Grasp the two black handles to which the latches are mounted, firmly, and slowly swing the roller assembly open. If the GSP is sitting flat, the mechanism may be rested gently against the view panel while the paper is loaded. **CAUTION: WHEN THE PRINT ROLLER ASSEMBLY IS RESTED OPEN, SUDDEN MOVEMENT OF THE GSP MAY CAUSE THE PRINT ROLLER ASSEMBLY TO FALL. THIS CAN CAUSE INJURY TO THE OPERATOR. BE SURE THE GSP IS STEADY, OR THE MECHANISM IS HELD OPEN SECURELY WHEN LOADING PAPER.**

INSERT PAPER ROLL:

Snap the roll of paper into the paper support blocks so that paper will feed from the underside of the roll. The outside surface of the paper roll is the one that must press against the printhead. Holding the edges of the paper evenly, pull approximately 12 to 15 inches of paper straight out. Check to see that top and bottom margins are spaced equally about the printhead. While holding the paper in that position, close the print roller assembly.

CLOSE PRINT ROLLER ASSEMBLY:

Slowly close the print roller assembly until the roller rests against the paper and printhead. Before seating the roller all the way, make any adjustments to the paper necessary to keep even margins. Once satisfied with the paper alignment, pull the slack in the paper tight towards the take-up chamber. As this is done, the print roller assembly will seat completely against the printhead. Again, lift the retractable plungers, and advance the roller latches to their full forward and locked position. The operator should be able to pull the paper manually, with moderate resistance, past the printhead.

THREAD THE PAPER THROUGH THE DRIVE MECHANISM:

Grasp the thumb screw on each pinch roller cams and rotate the cams towards the right of the unit. After doing this, there should be a 1/8 inch gap between the pinch and drive roller (the drive roller is coated with urethane). Thread the loose paper through the gap evenly, and pull all slack out. The paper should

rest flat against the view panel, and align parallel to the frame's top and bottom risers. If the paper does not align, re-open the print roller assembly and adjust the alignment. Rotate both pinch roller cams back towards the printhead to lock the pinch roller against the drive roller. The paper is now loaded and ready to attach to the take-up core.

INSTALLING THE TAKE-UP CORE:

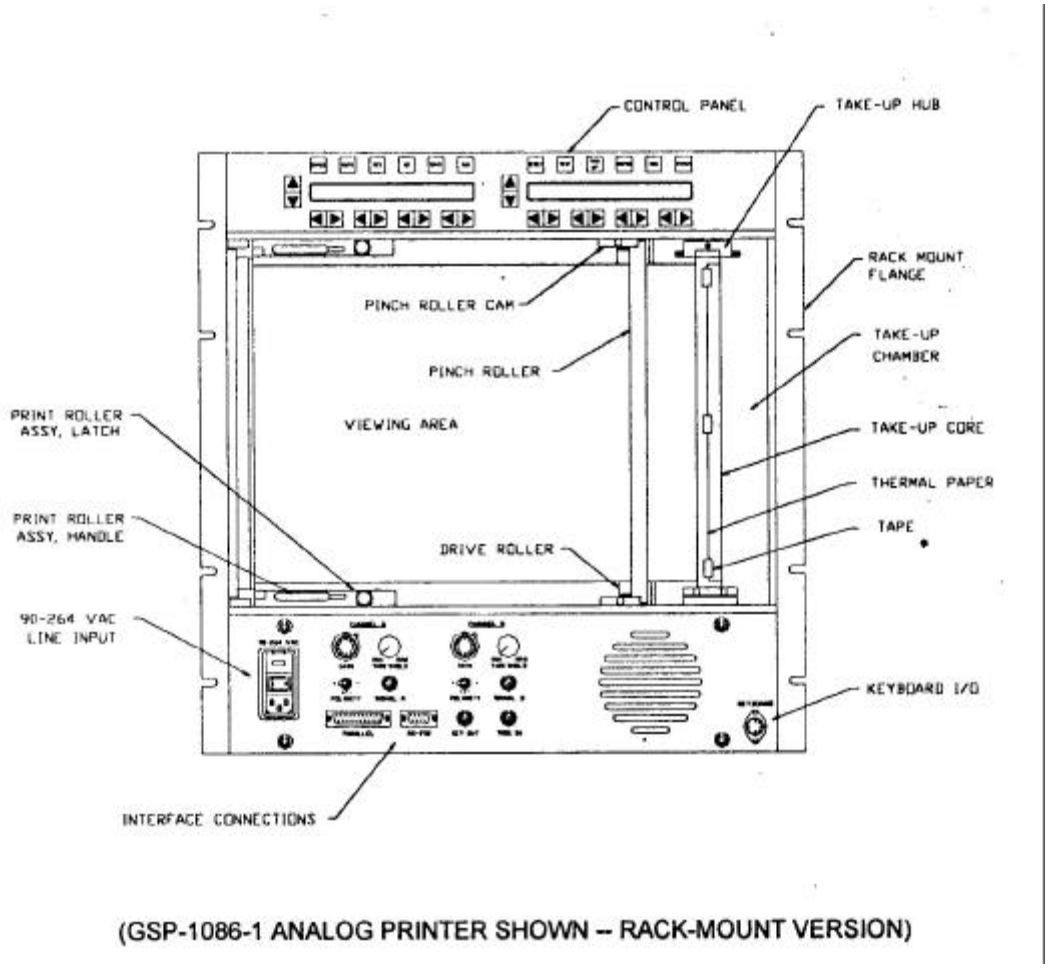
Once the paper is properly aligned and threaded, it can be attached to the GSP's take-up spool. The spool should be inserted in the take-up chamber such that one of the plastic end plugs seats into the support block at the bottom of the machine. The other end cap should then be snapped into the aluminum take-up hub that is affixed to the take-up motor. Two adjustable plungers protrude towards the center of the hub. These two plungers need to catch on the notches found on the take-up core's end cap.

ATTACHING PAPER TO THE TAKE-UP CORE:

With the core now properly installed, the end of the thermal paper can be taped to the core for winding recorded data. Advance enough paper so that the end of the paper is beyond the core. The paper should feed such that it rolls from underneath the core. With a razor or sharp knife, lightly cut the paper along the top surface of the core. Cut the line as straight as possible, being careful to not exert too much pressure, damaging the core. Use three pieces of tape to attach the paper to the core at the top, middle, and bottom.

Another technique that works well is to use a blade to cut the paper along the stainless steel pinch roller. By wresting the side of the blade against the roller (using the roller as a guide), a perfectly straight line can be cut. The paper can then be advanced just enough to wrap three quarters around the underside of the core for securing the tape along the top.

If the paper drifts or skews during operation, re-align the paper up at the printhead and try again. Also, there is a set screw in the bottom of each of the paper feed supports. The set screws are used to put a small amount of friction on the feed roll so that is does not vibrate and unravel. These set screws may need to be periodically adjusted.



(GSP-1086-1 ANALOG PRINTER SHOWN -- RACK-MOUNT VERSION)

FIGURE 2-1 GSP-1086 GENERAL LAYOUT

CHAPTER THREE
OPERATION

3.0 GENERAL

Once the GSP has been set up in accordance with **CHAPTER TWO** - ***INSTALLATION***, the unit is ready for operation. Depending on what type of data is being printed, a great deal of the information on how to print it will be contained in the appendix dealing with the primary data interface. **REGARDLESS OF THE TYPE OF DATA, ALWAYS TEST THE CHART DRIVE BY PRESSING THE "RAPID" BUTTON PRIOR TO PRINTING. A FAULTY CHART DRIVE CAN END UP CAUSING SEVERE DAMAGE TO THE PRINTHEAD.** Other aspects of controlling the GSP are common to all applications, such as using the control panel. Detailed instructions on these common operations can be found in the following paragraphs.

3.1 POWER UP

With the GSP suitably located and attached to the proper power source, it is time to turn the machine on. The power switch is located directly above the line input connector. The switch is labeled with a "1", denoting power on, and a "o" for power off. To energize the unit, depress the "1" side of the switch.

3.1.1 STARTUP SEQUENCE

Because the printer actually has a computer, it goes through a boot up sequence on power up. This will take approximately 15 seconds every time the machine is turned on.

During this period, the CPU (central processing unit) performs a number of tests on the system hardware. If a failure occurs at any point in this process, the BIOS (basic input and output system) on the CPU board will transmit two or more beeps. There may be a loose board or connector in this instance. Refer to **CHAPTER FOUR** - ***MAINTENANCE AND TROUBLESHOOTING.*** If the machine boots up properly, one short beep will be heard and display data will appear as it does in **FIGURE 3-1.**

3.1.2 PROGRAM LOADING

Shortly after the operating system is loaded, the system code will be loaded into memory and executed. When the program starts, several more hardware checks will be performed. If a failure occurs during one of these checks, the GSP will try to transmit the source of the problem on the left LCD display. Make note of any error messages and then contact EPC Labs.

3.1.3 CONFIGURATION LOADING

The GSP's internal code allocates memory and initializes a large data structure to maintain the various pieces of information it must manipulate. Each control element that can be changed from the control panel is analogous to a record in a database. The system tracks four different databases, called "config files". An operator can control which database is used to load the internal data structure on power-up. When saving the GSP's setup to one of the four possible config files, the operator has the ability to also save that file as the "power-on defaults" file. The power-on defaults file is the database that is loaded every time the unit is powered up.

3.1.4 SYSTEM READY

After the GSP-1086 has gone through its boot sequence, it is ready for operation. This is evident when the startup data is visible on the left and right LCD displays. When the system is ready to accept commands and data, the displays will appear similar to the display below:

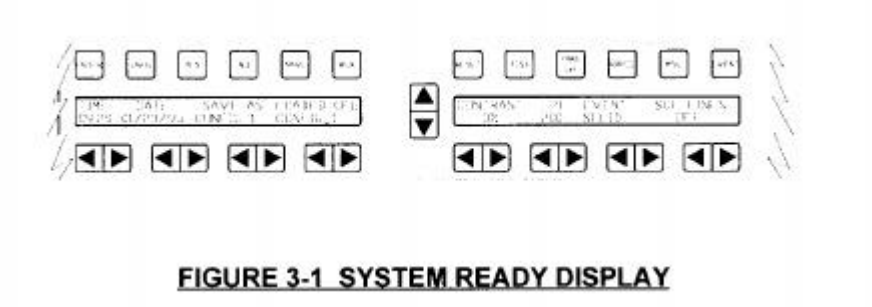


FIGURE 3-1 SYSTEM READY DISPLAY

FIGURE 3-1 SYSTEM READY DISPLAY

IMMEDIATELY AFTER BOOT-UP, THE 1086 IS AUTOMATICALLY PLACED INTO STANDBY MODE. THIS IS TO PREVENT ANY ACCIDENTAL PRINTING WITHOUT HAVING THE PAPER THREADED THROUGH THE DRIVE TRAIN. TO TAKE THE RECORDER OUT OF STANDBY, SCROLL TO THE "DATA INPUT" FIELD ON THE LEFT DISPLAY AND CHANGE THE SETTING TO SOMETHING OTHER THAN "STANDBY".

3.2 THE CONTROL PANEL

Although a variety of commands can be sent to the GSP over its different interfaces, the majority of the user interface will most likely occur at the system's control panel. The control panel is the primary user interface, providing switches for user input and displaying system feedback on its two LCD displays. Detailed descriptions of the panel's various functions can be found in the following paragraphs.

3.2.1 PANEL SWITCHES

The GSP's control panel has 32 different membrane switches for controlling the modes of operation. The twelve switches across the top are permanently silk-screened with their functions. The other switches are referred to as "soft keys", that is their functions are determined in software. The function of a given soft key depends on the information that is displayed next to that key on its LCD. This allows a small number of switches to control a large number of functions. It also allows the entire function of the printer to be re-defined without having to re-design all of the hardware. Not all of the switches are used in any one configuration. Regardless of what switches are active, the operation of a switch remains the same. When one of the membrane switches has been actuated, a slight tactile snap can be sensed by the finger. In some instances, holding the switch down will cause information on an LCD to continuously change. In other cases, the button must be released for a given piece of data to be modified. Any switch with a black arrow on it will be referred to as an "INC/DEC" switch. Switches pointing up and down are used to change the current menu being displayed on the adjacent LCD. Left/right pointing switches are used to change the data directly above the switch.

3.2.2 LCD LAYOUT

Because the "INC/DEC" switches (the ones with the black triangles on them) interact with display data, more frequently used functions are displayed on the right LCD. Conversely, data that are not likely to be changed by the operator often (time, date, config, etc.) Are printed on the left LCD. The format in which data are displayed is the same for both LCD’s. The top line of each display is dedicated to displaying a maximum of four function labels. An example of a function label would be the word “CONTRAST”. The bottom line of each display shows the data associated with the function header directly above it. A pair of "INC/DEC" switches is located directly underneath this data. The switches are responsible for changing the data directly above them. Together, the two displays are capable of providing the operator with status and control of eight different recorder functions at a given time.

3.2.3 MENU SYSTEM

The menu system on the GSP will vary depending on the interface configuration of a particular unit. Generally speaking, each menu, or menu group, will contain four pieces of data. As menu groups are scrolled, they will "roll over" after the last group is displayed, that is the first menu will appear again. To become familiar with the different menus, simply turn the unit on and use the up/down arrow keys to scroll each of the LCD’s.

3.3 MENU FUNCTIONS

Having defined the menu functions for the GSP's basic configuration, the use of these functions can now be examined. The control elements described in the following paragraphs are common to all variations of the GSP. For extended capabilities available with a specific configuration, refer to the appendix for that configuration (interface).

3.3.1 AUTO-EVENT CONTROL

The "AUTO-EVENT" field is used to automatically mark the printout at set time intervals. The interval can be set from one to 60 minutes (or 'off") in one minute steps. When enabled, an event will be printed at the set interval. The type of event printed is determined by the setting of the "EVENT" field. If "MESSAGE" is displayed in the event field, the current message will be printed with its current attributes when an interval elapses. The message command is described in greater detail later in this section.

3.3.2 BACKGROUND

The "BACKGROUND" field is used to control how printed messages appear with other printed data. If "DATA" is selected, an annotation string will be printed directly on top of other data. To knockout a white window behind the message, select "WHITE".

3.3.3 CONTRAST

To change the intensity of all printed data, increase the value of the “CONTRAST” field. Available values range from "-15%" for the lightest possible intensity to "+60%" for the darkest intensity. **EXTREME CAUTION SHOULD ALWAYS BE USED WHEN USING THE CONTRAST CONTROL. BECAUSE THE GSP CAN PRINT SO MANY DIFFERENT KINDS OF DATA AT A VARIETY OF SPEEDS, IT IS POSSIBLE TO SET THE CONTRAST TO EXTREMELY HEAVY VALUES. IF YOU NOTICE DARK DATA "BLEEDING" ON THE PAPER, REDUCE THE CONTRAST IMMEDIATELY.**

3.3.4 DATA TYPE

On several occasions, the value of a byte of data sent to the GSP will have different meanings coming from different host systems. Selecting a data filter will shift each received byte accordingly. A selection of "8BIT" in the "DATA TYPE" field will cause an ASCII 255 (OXFF) data byte to represent black. White is always defined as 0 (0x00). The value of black will always be the highest bit value selected in the data type field. Intermediate levels of gray will fall within the defined range.

3.3.5 DATE

The “DATE” field displays the calendar date in mm/dd/yy format. Holding date's INC/DEC buttons down for several seconds will cause the date to change at a faster rate. The value set in this field will be printed with all ‘DATE’ messages.

3.3.6 POWER-UP DIAGNOSTICS

When the 1086 boots, the internal software checks all available hardware and loads the appropriate menus for the interfaces that have been installed. The results of these tests are flashed on the left LCD at 1.5 second intervals prior to system ready. If the 'P/U DIAGS 'field is toggled to 'DISABLED', the results of the tests will not be displayed the next time the machine is powered up.

3.3.7 EVENT

On continuos records, such as surveys and spectrum analysis, it is sometimes useful to print event marks to reference time or significant events. The GSP offers four different types of event marks in its “EVENT” field. An event mark is printed every time the “EVENT” switch is pressed (top right of panel) or an auto-event interval expires. A selection of "SOLID", "TICK", and "DASHED" refer to the type of line that will be printed for an event of that type. If “MESSAGE” is selected, the current message will be printed using the

current message attributes. See the paragraph on “MESSAGE” for a detailed description of the message function.

3.3.8 IMAGE INVERSE

When printing image type data, it is occasionally desirable to print the inverse value of the data. This is analogous to looking at the “NEGATIVE” of black and white photograph. To achieve this effect, select “NEGATIVE” in the "IMAGE" field. What the GSP is doing in reality is printing the bit-wise compliment of each data byte received. Always be prepared to change contrast settings when "INVERSE" is selected. Printed data may end up being much heavier.

3.3.9 DATA INPUT

The data input field is used to select which interface (serial or other) will receive external data being sent to the GSP. The options in this field will vary based on the configuration of the unit. When "RS-232" or "RS-422" is selected as a data input, the printer will not decode serial commands. It is assumed that raw data will be sent over the RS-232 (or RS-422) port for printing. If a non serial interface is selected, the RS-232 port can be used to decode serial commands. If it is desired to alternately use the RS-422 interface to decode commands, please consult EPC Labs.

3.3.10 LINES PER INCH

Some types of printing require the need to control the spacing between each printed line. In line scan recorders, this ultimately controls how fast the paper moves through the device. In the "LPI" field, four possible selection allow such control. The fastest speed, 75 LPI, will space each printed line at 0.013 inches apart. The slowest speed, 200 LPI, prints the lines at a pitch of 0.005 inches. Because the pixels on the printhead are spaced at 203 DPI, a setting of 200 LPI will yield an aspect ratio of 1:1 for image data. If chart drive is to be controlled by an independent clock source, the external clock input can be enabled by setting the LPI field to "EXT".

3.3.11 MARGIN

Printed messages (text strings) can have different characteristics about their size, location, and background. These characteristics, called attributes, can be independently set. The margin control is an attribute for the message function of the GSP. The data in the margin field determines where, in relationship to the bottom margin, a text message is printed on the paper. The units are in inches and range from zero inches (bottom of printout) to 10 inches (top of printout). If there is not adequate space for a message to print, it will be truncated.

3.3.12 MEDIA(PAPER TYPE)

The GSP is capable of printing on two types of media; thermal paper and high grade plastic film. Because the dynamic response curves for these two media are different, the GSP needs to know which type, paper or film, is being used. No harm will come from an incorrect setting in the "MEDIA" field but print quality may be compromised.

3.3.13 MESSAGE

The message function is probably the most comprehensive function found on the GSP. Its output is effected by a variety off characters. In general, the message field determines what text string will be printed on the record when a message command is executed. The manner in which the string is printed will depend on the settings of the "MARGIN", "BACKGROUND" and "CHAR SIZE" fields. The actual execution of the message function, that is the event which causes the message to print, may result from a

remotely received command, an event command, or the pushing of the "MSG" button on the control panel. Refer to paragraph 3.4 for more details on how to use the message function.

3.3.14 SAVE CONFIG

At any point during operation, the GSP's configuration can be saved to flash memory by pressing the "SAVE" button on the top row of panel switches. When this occurs, all system data is written to the config file named in the "SAVE AS" field. Changing the file name in this field does not save the data, but merely sets the file that the data will be saved to when “SAVE” is pressed. Immediately after a “SAVE”, the left LCD will ask the operator if he or she wishes to use those settings the next time the unit is powered up. The "YES" and "NO" buttons are used to answer this prompt.

3.3.15 SCALE LINES

In some applications it is necessary to print lines of equal graduation along the time axis of a record. Typically, these lines represent depth or range and are referred to as scale lines. The "SCL LINES" field can be used to set how many horizontal lines (5,10,20, or none) will be printed.

3.3.16 SCALE LINE INTENSITY

If scale lines are being used, the darkness that they are printed at can be controlled by the "SCL SHADE" field. There are four options for selecting a percentage of black -- 25%,50%,75%, and 100% (black).

3.3.17 MESSAGE SIZE

As mentioned earlier, the "CHAR SIZE" function is an attribute of printed messages. The data in this field controls the width and height of printed characters. Each character is represented by an 8 dots wide x 9 dots high matrix. The value set in the “CHAR SIZE” field is a direct multiplier to the width and height dimension in the matrix.

3.3.18 SHADES OF GRAY

The number of different gray levels that a pixel can produce on the paper is selectable. Setting higher values in the "SHADES" field will produce images of greater quality but tend to slow the print speed down. Values of 8,16, 32,64,128, and 256 are available. It is worth noting that selecting a level of "256" when the source data only has 16 possible levels (4 bit data), is only going to slow the machine down.

3.3.19 LOADED CONFIGURATION

The GSP maintains four complete sets of internal data in files named "CONFIG-1" to "CONFIG-4". Any one of these files can be loaded during operation of the printer. As the file names are scrolled in the "LOADED CFG" field, the internal data structure is updated with the information in the active config file. A small disruption in printing may be noted while the new settings are loaded. If the settings are radically different from the previous settings, the changes will be evident in the printout. Care must be taken when printing heavy data at low contrast levels. Loading a new configuration with large contrast values could strain the printhead, reducing its life cycle.

3.3.20 TIME OF DAY

When the "time" field is visible to the operator, the GSP's internal clock can be updated using the INC/DEC keys. The longer one of the keys is held down, the faster the time will change. Hours and minutes are displayed in 24 hour military format.

3.3.21 BAUD

The “BAUD” field is used to set the transmission speed of serial data being sent to or from the unit. Available selections range from 1200 baud to 115.2 kilobaud. Data format is always eight data bits, one stop bit, and no parity (8,1,n).

3.3.22 IMAGE WIDTH

The "WIDTH" field is used to set the number of active pixels for printing digital data. The setting applies to all digital type interfaces.

3.3.23 ENTER KEY

The “ENTER” key, found on the top left side of the panel is used to answer LCD prompts in some of the GSP's extended features.

3.3.24 CONFIGURATION KEY

The "CNFG" key, found next to the "ENTER" key, is used in the extended features of the GSP. The basic configuration of the printer does not make use of this particular switch.

3.3.25 YES KEY

Various functions that are implemented on the GSP, such as saving files, require the operator to answer a screen prompt from the left LCD. When the printer asks "SAVE AS POWER ON DEFAULTS?", The “YES” and “NO” buttons allow the operator to answer the prompt.

3.3.26 NO KEY

Located next to the "YES" button, the "NO" switch allows an operator to answer various screen prompts.

3.3.27 SAVE KEY

The “SAVE” key, above the left LCD, is used in conjunction with the "SAVE AS" field. When “SAVE” is pressed, all active settings will be written to the flash memory file named in the “SAVE AS” field. After the file is saved, the left LCD prompts the user with "SAVE AS POWER-ON DEFAULTS". Pressing the “YES” button at this point will cause to GSP to recall the active settings the next time the printer is turned on. Pressing the “NO” button at this prompt will cause the last power-on settings to be used.

3.3.28 AUXILIARY FUNCTIONS

The “AUX” switch, above the left LCD, is a general purpose switch for calling any auxiliary software utility that may have been purchased with the GSP. In the core configuration, the “AUX” button will not implement any action.

3.3.29 HARDWARE RESET

Like many PCs, the GSP-1086 has a hardware reset control on its front panel. Pressing the "RESET" switch, above the right LCD, will shunt the microprocessors reset line to ground and cause the system to re-boot. Sometimes this action is necessary when external equipment causes the GSP to hang up. After

the reset switch is pressed, the unit will appear to do nothing. Because reset is a "soft" reset, the data that was on the displays will remain on the displays while the unit is re-booting. Allow about ten seconds for the unit to return on line.

3.3.30 INITIATING TEST PATTERN

It is very important to periodically test the health of the GSP's printhead and chart drive mechanism. For this reason, the GSP has an internal test pattern which should be run after power-up. The pattern is continuous and will print out various tone levels and system settings. Pressing any key during the test routine will cause the test to stop and the GSP to return to normal operating mode.

3.3.31 ENABLING TAKE-UP

Once the thermal paper is installed in accordance with **CHAPTER TWO**, and the end of the paper is securely fastened to the take-up core, the take-up motor must be enabled. Pressing the "TAKE-UP" switch turns the motor on. Pressing the switch again will toggle the motor off.

3.3.32 RAPID CHART ADVANCE

The rapid advance function of the GSP is similar to the "form feed" control on any line printer. Pressing the “RAPID” switch on the control panel will cause the paper to move through the recorder at approximately one inch per second. All printing is disabled during this time. After rapid has been enabled, pressing any key will stop the rapid chart advance.

3.3.33 PRINTING CURRENT MESSAGE

The “MSG” switch is used to overlay a text message with data that is currently being printed. The size, location, background, and contents of the message are determined by various other fields and commands. All message attributes are setup in a menu group on the right LCD. To print user defined messages, the "FILLBUFF" command must be used to load one to three empty message buffers. For more information on the FILLBUFF command, refer to **APPENDIX A.**

3.3.34 PRINTING EVENT MARKS

On continuous records, it is sometimes necessary to print a line, dashed line, tick mark, or message to denote a significant event. The “EVENT” switch, located on the top, right-hand side of the panel, does just that. Depending on what the value of the “EVENT” field is, the record will be marked accordingly when the event switch is pressed.

3.4 PRINTING MESSAGES

As stated before, the use of the message facility on the GSP is fairly involved. The printing of messages entails the following steps:

1. **SETTING THE MESSAGE ATTRIBUTES.**
2. **SELECTING A MESSAGE TO PRINT.**
3. **EXECUTING A MESSAGE COMMAND**.

The following paragraphs describe each of these steps in detail.

3.4.1 SETTING MESSAGE ATTRIBUTES

Message attributes are those controls which effect how a printed message shows up on the paper. The message attribute fields are "MARGIN", "CHAR SIZE", and "BACKGROUND". Prior to executing a message command, these fields should be set to suit the operator's application. Since print speed changes when messages are being printed, it is generally a good idea to keep annotation short and uses a small "CHAR SIZE".

3.4.2 SELECTING MESSAGE TO PRINT

When a message command is executed, the current message will be printed. The current message is the message string that is visible in the “MESSAGE” field. Seven different options exist for this field. Three of the options ("TIME", “DATE”, and "SETTINGS") are fixed. Selecting any of these three will cause its data to be printed. Three more of the options ("Ul", "U2" and "U3") are user definable with the remote command "FILLBUFF". When a user ("U#") buffer has been filled with the FILLBUFF command, the first nine characters of the buffer will be displayed in the field in place of the "u#" string. The FILLBUFF command is implemented over the keyboard or serial interface and is described in the interface appendix. The seventh option "$GPGGA" is a unique message that relates only to printing data received from a GPS (global positioning system) receiver.

3.4.2.1 PRINTING GPS DATA STRINGS

The GSP-1086 is capable of decoding one NMEA-0183 standard data sentence from a GPS receiver and printing zulu time, latitude, and, longitude on the record (in the current attributes). The receiver must be interfaced to the RS-232 port at 4800 baud with eight data bits, one stop bit, and no parity. Furthermore, the receiver must provide the "$GPGGA" data sentence as seen in the message options. The data sentence must be terminated with a "CR\LF" sequence (OXOD/OXOA). The GSP's data input cannot be set to "SERIAL" and no other remote commands will be decoded when using this option. Most likely, this feature will be used to print time/LAT/LON on a record at a set interval using the "AUTO-EVENT" feature.

3.4.3 EXECUTING A MESSAGE COMMAND

The execution of a message command is the actual event that causes a text string to be printed on the paper and can be implemented in any of the following ways:

FROM THE CONTROL PANEL

*By pressing the “MSG” button

*By pressing the "EVENT" button when "MESSAGE" is displayed in the “EVENT” field

AS A REMOTE COMMAND

* By sending or keying the command "MES" or “MESSAGE” followed by a message number (1 -7) or literal message string

Ex. Sending "MES 1" will cause message buffer 1 (ul) to print. Sending "MES HANG ON MONTE" will cause "HANG ON MONTE" to print.

* Sending or keying the command "eve" or “EVENT” when “MESSAGE” is the current setting in the "EVENT" field.

AS AN AUTO-EVENT MESSAGE

When "AUTO-EVNT" is set to an interval (not "off"), and “MESSAGE” is the current setting in the "EVENT TYPE" field, the current message will print regularly at that interval. When printing transient GPS data, manually printing the GPS data string (by pressing event) will cause the GPS data for that auto-event period to be spent.

3.5 A WORD ABOUT CONTRAST

The GSP is a multi-purpose printer that was designed to fit a wide range of applications. The technology of thermal printing requires that pixels be turned on for relatively long lengths of time when printing at slow line rates (250 ms or longer). In these applications, it may be necessary to set the contrast to a high value, like "30%" for data to print with proper intensity. If print speed were to increase rapidly, to something like 20 ms per line, data would begin printing extremely heavy, putting undue strain on the printhead. For this reason, **IT IS ALWAYS A GOOD IDEA TO REDUCE THE CONTRAST TO MINIMAL LEVELS WHEN CHANGING PRINT SPEED. THE CONTRAST CAN THEN BE INCREASED SLOWLY UNTIL THE IMAGE LOOKS CORRECT.**

3.6 EPC LINK SERIAL UPGRADE UTILITY

Should there be a need to update the system code or if an operator wishes to upgrade his or her printer, the internal software will need to be replaced. Because this code is stored in flash memory, it can be updated using the RS-232 interface. After the upgrade, an operator simply resets the machine and the new code will boot. Serial upgrades involve the following steps.

1. CONTACT EPC LABS FOR NEW PROGRAM CODE.

2. ATTACH THE RS-232 PORT ON THE RECORDER TO A FREE COM PORT ON THE PC. A NULL MODEM MUST BE USED ON ONE END OF THE CABLE.

3. SET THE BAUD RATE ON THE GSP TO 115,200 AND MAKE SURE THAT "DATA INPUT" IS SET TO STANDBY.

4. HAVING COPIED THE NEW PROGRAM CODE TO THE APPROPRIATE DIRECTORY ON THE UTILITY DISKETTE, LOG ONTO THAT DRIVE AND TYPE THE FOLLOWING COMMAND AT THE DOS PROMPT:

GSPSEND COMX 115200

REPLACE THE "x" WITH THE NUMBER OF THE COM PORT BEING USED. IF THE PC DOES NOT SUPPORT 115200 BAUD, CHANGE THE VALUE ON THE COMMAND LINE AND THE 1086 TO A SUPPORTED SPEED.

5. FOLLOW THE DISPLAY PROMPTS ON BOTH THE LEFT LCD AND THE COMPUTER SCREEN. YOU WILL BE PROMPTED TO REPLACE EACH SYSTEM FILE THAT IS EFFECTED.

6. RESET THE GSP WHEN ALL FILES HAVE BEEN REPLACED.

The new program code will not be copied to the flash memory until each prompt is answered by pressing the ‘YES’ button. Most of the files are small support files and will transfer in about a second. The actual executable program that runs the machine will take 10 to 20 seconds to transfer at 115200 baud. If you have any reservations about updating the code, respond 'no' to the prompt following the transfer of the executable.

CHAPTER FOUR
MAINTENANCE

4.0 GENERAL CARE

ALWAYS UNPLUG THE UNIT BEFORE ATTEMPTING ANY MAINTENANCE ACTION. FAILURE TO UNPLUG THE UNIT DURING MAINTENANCE PROCEDURES MAY RESULT IN SEVERE DAMAGE TO THE UNIT AND BODILY HARM TO THE OPERATOR!

A major part of the routine maintenance of the GSP should be keeping the area around the printer clean, dry, and free of debris. Excess moisture, such as sea-spray can cause the electronics inside the unit to short circuit. Foreign particles can damage the rollers and the printhead. These situations can be avoided by routinely cleaning the area around the printer.

4.1 CLEANING

The outer surfaces of the GSP should be wiped down periodically with a damp rag. Water and alcohol are generally acceptable solvents for cleaning the unit. Clean the printhead after every roll of paper. This is accomplished by running an alcohol swab or pad along the length of the element line several times. If the unit is frequently used, the view panel should be removed once a week and the electronics chamber should be inspected for debris. If foreign particles are found, the boards should be removed and the cavity should be vacuumed out.

4.2 TROUBLESHOOTING

In general, there are not many component failures that are difficult to diagnose. If there seems to be a problem printing, run through the following check list:

1. FULL MODEL NO: SERIAL NO.

2. DATE PURCHASED:

3. DOES THE MACHINE PASS SELF TEST?	**YES**	**NO**
4. IS DATA ON BOTH LCDs READABLE?	**YES**	**NO**
5. CAN MENUS BE SCROLLED?	**YES**	**NO**
6. DOES THE "RAPID" SWITCH WORK?	**YES**	**NO**
7. DOES THE TEST PATTERN PRINT?	**YES**	**NO**
8. DOES EXTERNAL DATA PRINT AT ALL?	**YES**	**NO**
9. IS EXTERNAL DATA OUT OF SYNCH?	**YES**	**NO**
10. ARE THERE STREAKS ON PRINTOUT?	**YES**	**NO**
11. ENTIRE SECTION OF DATA IS MISSING?	**YES**	**NO**

A "YES" answer to any of the items above means that there may be something wrong with the unit. The following paragraphs described some procedures that may immediately fix the problem before having to call EPC Labs.

4.2.1 BOOT FAILURE

A system boot-up failure will usually be evident by several beeps during the boot up sequence. Such a failure may also be evidenced by the LCD's appearing to be illuminated but not displaying anything. If absolutely nothing happens when the unit is turned on, and the line source has been tested to work, the power supply has most likely been damaged. If a boot failure is suspected, it may be fixed by checking to see that the circuit boards are firmly inserted in the backplane. The circuit boards are located underneath the cover that the paper moves across.

4.2.2 GARBLED OR MISSING LCD DATA

If data appears to be garbled or missing from one or both LCD displays, there may be a loose cable connection somewhere between the LCD and the digital I/O board that drives it. The connection of the two 50 pin headers at the digital I/O board should be checked. The digital I/O board will be the only board on the bus that has two 50 pin receptacles on it. By carefully removing the control panel, the connection of the LCD's to the motor drive board can be inspected. LCD connectors should be re-attached to the single-row header that is closest to them. The cable should not need to be twisted or bent to reach the connector. If it is uncertain how to re-attach a loose connector, do not guess! Call EPC Labs. The left LCD connects to the header labeled "P5" and the right LCD connects with "P4". Both connectors should be oriented such that the black wire in the harness connects to the third pin on the header (from the chart motor side of the unit). You will notice that there is one empty pin on each connector that hangs over the edge of its header (towards the printhead).

4.2.3 NON-RESPONSIVE PANEL SWITCHES

If some or all panel switches do not seem to work, the ribbon cable connections on the digital I/O board should be checked, as described in Paragraph 4.2.2. The cable connection on the panel itself should also be examined. If some switches work while others do not, there may be a component level failure on the digital I/O board, contact EPC Labs in this instance.

4.2.4 NO "RAPID" ADVANCE

The operation of the chart drive should always be tested before printing by pressing the "RAPID" switch. If "RAPID" does not seem to work, the control panel should be carefully removed to examine the chart motor gears and circuitry. If there do not appear to be any loose connections in this area, one of two problems probably exists. Although the large, 50 pin ribbon cable may seem to be fully engaged into the motor drive board, the other end of that cable may be loose in the digital I/O board (in the electronics chamber). This would inhibit control information from getting to the chart drive timing pal. You will want to check this connection before making any other diagnosis. If, finally, all cables seem to be secure in their various locations, and the problem still persists, the chart drive module may have somehow become damaged. In this case, contact EPC Labs for further information on how to be certain that this is the problem. **IMPORTANT: NEVER TRY TO PRINT WHEN THE CHART DRIVE IS INOPERATIVE, SEVERE DAMAGE MAY BE CAUSED TO THE PRINTHEAD.**

4.2.5 NO TEST PATTERN

If the chart appears to move properly, but no test pattern prints there is probably a loose connection between the printhead and the ISA control board. The view panel should be removed to insure that the printhead control cable is attached to the ISA controller. The ISA controller will have the words "EPC Labs ISA control board" screened just above the 26 pin or header where the cable should be connected. The harness will already be bent for a natural connection to that header. If the other end of the cable has popped off the printhead, it will be evident when the power supply shield is removed. The power supply shield is the black sheet metal cover located in the paper feed chamber.

4.2.6 NO EXTERNAL DATA

If the printer passes all self tests and seems to print the internal test pattern correctly, it means, most likely, that there is nothing wrong with the unit. Problems printing external data usually result from improper menu selections, poor interface connections, or the wrong format of data being sent from the host. Reading the interface appendix will solve a good portion of these types of problems. Still, it may be a good idea to trace the cable connections from the I/O panel back to the board that the cable is meant to

connect with. If the paper actually moves through the printer when data is sent, but nothing shows up on the record, the contrast may need to be increased or the data type may need to be changed.

4.2.7 DATA OUT OF SYNCH

If the unit appears to print external data at the proper intensity but does not stay synchronized (straight lines "walk" across paper), one of several conditions probably exists. Driving digital parallel data down long cables can cause headaches. Test data transmission with a short (6 foot) cable to quickly see if this is the problem. The GSP must receive 2048 bytes of data per scan line. A line of data will not be printed until the 2048th byte is received. If the unit was printing fine and somehow lost synch, the FIFO memory and associated byte counter can be reset by pressing the “ENTER” key. If this does not fix the problem, the host, in all likelihood, is not sending 2048 bytes per line. Loss of synchronization with analog data almost always results from improper key pulse configuration. Refer to the proper appendix for operation of the installed interface.

4.2.8 STREAKS IN DATA / MISSING DATA

Streaks in data are usually caused by a dirty printhead. If the streaks persist after cleaning, the printhead may be damaged. Blown pixels usually appear as crisp white lines running through the data along the time axis. Ragged horizontal lines usually indicate that the head needs a good cleaning. If an entire section (quarter of display) seems to be missing, check the connections between the printhead and the ISA controller (paragraph 4.2.5). If those connections are good, there is probably a blown I.C. on the printhead or one of the contacts on the strobe signals is loose inside one of the connector housings.

4.2.9 FAILED DIAGNOSTICS

If power-up diagnostics are enabled, status on the system interfaces will be provided on the left LCD during the power on sequence. If any of the register or timer tests return with a "FAILED" result, there has been a component failure on the EPC Interface board or the board has become unseated. In either case, check to see that the board is seated first, and then troubleshoot the following components:

MESSAGE	REF	PKG	MFG
KEY TIMER FAILURE	U7	8254	INTEL/HARRIS
SCAN TIMER FAILURE	U8	8254	INTEL/HARRIS
STROBE TIMER FAILURE	U19	8254	INTEL/HARRIS
REGISTER B/C FAILURE	U14	8255	INTEL/HARRIS

4.3. REPLACEMENT PROCEDURES

ALWAYS WEAR AN ANTI-STATIC WRIST STRAP WHEN PERFORMING MAINTENANCE ON ANY ELECTRONIC COMPONENT. FAILURE TO DO SO MAY DAMAGE OTHER, NEARBY COMPONENTS.

EPC realizes that it is not always convenient to send a malfunctioning unit back to the factory. If a problem is easily diagnosed and the fix is relatively simple, EPC will ship the replacement part(s) to the site. The following paragraphs describe replacement procedures for some of the major components. After replacing a component, perform an operational test by running internal test pattern. Immediately ship components known to be faulty back to EPC Labs.

4.3.1 CIRCUIT BOARD ON BUS

The basic boards in the GSP can be identified in the following manner:

* ISA Control Board - has the "EPC LABS ISA CONTROL BOARD" screened onto the PCB. This board is usually mounted closest to the printhead.

* Microprocessor Board - usually mounted closest to the take-up chamber, this board will have three headers along the top and one or two SIMM memory modules mounted at the rear of the board. It is a half size card that has surface mounted components on both sides.

* Digital I/0 Board - mounted in one of the middle slots, this board has two 50 pin ribbon cables connected to it. The board can also be identified by the four 8255PPI chips mounted to it (40 pin dip packages).

* EPC Interface Board - usually next to the microprocessor board, the EPC interface board can be identified by the screening "analog interface board" on

To replace a circuit board on the bus, the view panel must be removed for access to the electronics chamber. Use a small hex wrench set to do this. Assuming that EPC has shipped the appropriate replacement board to the site, find the board in the passive back plane that matches the replacement part. Make note of every cable connection on the faulty board. Use a small hex wrench to loosen the card edge bracket. Be careful not to drop the fastening screw into the electronics. Gently lift the bad board out of its finger edge connector. Disconnect any cables that are still connected. Connect any loose connectors to the new board and insert the board into the same slot. Reverse previous steps to re-assemble the machine.

4.3.2 PRINTHEAD

Replacing a printhead is relatively simple. Disconnect the connectors attached to the printhead while the head is still mounted to the riser. As with any cable, try to remove the connectors by prying on the connector housing, not pulling on the wires that go into the housing. After removing the connectors, locate the four access holes on the printhead side of the case, just behind the printhead. Remove the four slotted screws securing the printhead to the frame, the head will come free. Tag the head as defective, put it in an anti-static bag and return it to EPC Labs for evaluation. Connect the new printhead to the two harnesses and re-install it into the printer by reversing previous steps.

4.3.3 POWER SUPPLY

REMOVING THE POWER SUPPLY INVOLVES:
DISCONNECTING DISCRETE WIRES THAT PROVIDE DIFFERENT VOLTAGES TO DIFFERENT ASSEMBLIES. BECAUSE AN INCORRECTLY INSTALLED POWER SUPPLY CAN VIRTUALLY DESTROY EVERY COMPONENT IN THE MACHINE, THIS MAINTENANCE ACTION REQUIRES A TRAINED TECHNICIAN THAT CAN PAY CLOSE ATTENTION TO DETAILS. EPC HIGHLY RECOMMENDS CALLING A QUALIFIED EPC TECHNICIAN TO AID IN THE REPAIR. IF NOT COMFORTABLE USING A VOLT METER OR AN OSCILLOSCOPE, THE UNITSHOULD BE RETURNED TO THE FACTORY.

Remove the printhead from the unit by following paragraph 4.3.2, above. Use a Phillips head screwdriver to remove the two black plates covering the power supply. The larger of the two plates has the optic paper sensor mounted to it -- which is connected to a wire harness underneath the plates. Be careful not to lift the plate out of the machine without first disconnecting the sensor. All of the connections at the supply should now be visible. As a safety precaution, sketch up a diagram of where all the various wires connect and then disconnect every one of them. The two mounting screws for the power supply can be

removed through access holes on the side of the case (just like the printhead). The print roller assembly will need to be removed as well. This is accomplished by removing the two pivot screws that it swings on**.** After the printhead and print roller have been removed, the defective supply can be lifted straight out of the unit. Tag it as defective and ship it back to EPC Labs for analysis. Reverse the previous steps to install the new supply.

IT IS EXTREMELY IMPORTANT TO WRITE DOWN WHERE ALL THE CONNECTIONS ARE. INCORRECTLY CONNECTING THE NEW SUPPLY MAY CAUSE SEVERE DAMAGE TO SEVERAL COMPONENTS IN THE MACHINE. USE EXTREME CAUTION.

4.3.4 DE-CASING THE UNIT

It may seem easier to conduct some maintenance actions with the unit removed from its sheet metal case. Specifically, problems on the chart drive mechanism are difficult to work on because space behind the control panel is very limited. To remove the unit from its case, follow the steps below exactly. When re-casing the unit, be certain to follow the steps in exact reverse order. Always be careful not to pinch wires or bend cables.

1. STAND THE UNIT UP ON ITS EDGE WITH THE BACK OF THE UNIT FACING YOU. REMOVE THE FOUR RUBBER FEET WITH A 7/64" HEX HEAD DRIVER.

2. WHILE THE UNIT IS STILL UPRIGHT, USE A 5/64" HEX HEAD DRIVER TO REMOVE THE SIX FLAT HEAD SCREWS ALONG THE TOP OF THE CASE. THESE ARE THE SCREWS SECURING THE CONTROL PANEL TO THE CASE.

3. REMOVE THE SCREWS ALONG THE INSIDE OF THE CONTROL PANEL SO THAT THE PANEL CAN BE LIFTED AWAY FROM THE MACHINE. CUT ANY CABLE TIES SECURING CABLES TO THE INSIDE OF THE CASE AND THEN RE-ATTACH THE PANEL TO THE FRAME OF THE UNT BY REPLACING THE SCREWS YOU JUST REMOVED. DO NOT REPLACE THE SCREWS THAT WERE HOLDING THE PANEL TO THE CASE (THE SCREWS FROM STEP 2).

4. LAY THE UNIT FLAT FOR THE REMAINDER OF THE DECASING. USING A 6/32" HEX HEAD DRIVER, REMOVE THE TWO 10-32 CAP HEAD BOLTS ON THE BOTTOM OF THE I/O PANEL. THESE ARE THE TWO BOLTS SECURING THE I/O PANEL TO THE CASE.

5. USING A BLADE SCREWDRIVER, REMOVE THE FOUR FLAT HEAD SCREWS ON EACH SIDE OF THE UNIT. THESE EIGHT SCREWS BOLT INTO THE ENDS OF THE RISERS AND ARE RESPONSIBLE FOR SECURING THE FRAME TO THE CASE.

6. CLOSE THE ROLLER ARM ASSEMBLY AND SLIDE THE LATCHES FORWARD. GRASP THE TOP LATCH HANDLE WITH ONE HAND AND THE LOWER PORTION OF THE DRIVE ROLLER WITH THE OTHER HAND. CAREFULLY LIFT THE FRAME STRAIGHT OUT OF THE CASE. ON A STABLE SURFACE, STAND THE FRAME UP ON THE PRINTHEAD RISER. MAINTENANCE MAY NOW BE PERFORMED ON THE UNIT.

4.3.5 LCD MODULE

If one of the LCD modules fails, the control panel will need to be removed from the unit. There are six mounting screws (7/64" hex head) located on the riser and four more flat head screws holding the panel to the outer case. Remove the four flat head screws (5/64" hex head) first. To remove the six 6-32 screws holding the panel to the riser, the view panel will first need to be removed (to get at the middle two screws). Once the six riser screws have been removed, the panel comes free from the rest of the unit but will still be connected via the service loops on the various component cables. Carefully disconnect the ribbon cable, the LCD cables and the small twisted pair connecting the panel to the rest of the unit. After laying the panel face down on a non-abrasive flat surface, the faulty LCD display can be removed using a small hex head driver. Note that there is no washer underneath the mounting screw closest to the cable. This is to avoid shorting any of the cable connections. Reverse the previous steps to install the new LCD into the printer. When re-connecting the LCD connectors to the motor drive board, be certain that the left LCD harness connects to the header labeled "left LCD", etc.

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APPENDIX A
INTERFACE SPECS

APPENDIX A
EPC GSP-1086 SERIES
INTERFACE SPECIFICATIONS

AI.0 GENERAL

NEVER CONNECT OR DISCONNECT INTERFACE CABLES (SERIAL, ANALOG, PARALLEL, KEYBOARD, OR OTHER) WHEN THE GSP IS ON. DOING SO MAY CAUSE DAMAGE TO THE COMPONENTS IN THE INTERFACE CIRCUITS.

This appendix to the GSP operator's manual contains complete information on how to interface to the GSP-1 086 series of recorders. Because the 1086 is offered in a variety of configurations, some of the information in this section will not apply to your particular unit. In the following paragraphs there are detailed descriptions on how to interface to the hardware, remotely control the 1086 with the GSP command language, and print digital and analog data.

A2.0 COMMAND PROTOCOL

The majority of the functions on the control panel of the GSP can be implemented remotely over the keyboard interface or the active serial interface (RS-232 or RS-422). Regardless of which interface is used, the theory of how the command language works is the same. The GSP receives bytes of data, one at a time, and stores them sequentially in a buffer. When a "terminator" is detected, the text string is decoded. A terminator is a carriage return character ('\r', DEC 13, OXOD), a line feed character ('\n', dec 10, OXOA), or both.

After either of these characters is detected, the ASCII string that has been built in the buffer is assigned to the decoding routines. If the string that is sent does not match any command in the command set, or one of the arguments to the command is invalid, an error message will be displayed on the left LCD. Error conditions cause the machine to produce a tone and stop any printing that may be in progress. This is to assure the operator understands that the command sent is not valid. The following sub-paragraphs describe how to use each of the command interfaces and detail the exact syntax of the entire command set.

A2.1 THE KEYBOARD INTERFACE

The keyboard interface is extremely easy to use. When the machine is **off**, simply plug a standard "qwerty" type keyboard plug into the jack marked "KEYBOARD" on the I/O panel and turn the unit on. On the left LCD, there is a field for "kb enable", make sure this is set to "ENABLED". You are now ready to enter commands from the keyboard. To test the interface type, the following, exactly as it appears below:

FEED 3.5

As you type, the characters will appear on the second line of the left display. There is no backspace or line editing facility. If you make a mistake, press [ENTER] and start again. After typing the string correctly, press [ENTER]. If the paper advances 3.5 inches, the command was implemented properly. If the machine beeps and displays an error message, try again.

A2.2 THE SERIAL INTERFACES

The 1086 analog GSPs are shipped with access to one serial interface, labeled "RS-232", on the front of the unit. If so desired, the RS-232 interface connector can be used to connect with an RS-422 port inside the machine. To accomplish this, simply remove the microprocessor board and switch the serial ribbon cable to "COM2" on the card edge (the other nine pin connector). Then, when "RS-422" is selected as the data input from the control panel, the proper hardware will be addressed. The pin assignments for either interface can be found in paragraph A2.2.2 and paragraph A2.2.3 respectively. Command strings received over the RS-232 interface are decoded in the same manner as commands typed in over the keyboard interface. Refer to paragraph a2.1 for a description of this process. It is important to note that commands will only be decoded when "DATA INPUT" is not set to "RS-232" or "RS-422". All digital type 1086s have access to the RS-422 interface at the interface panel via a dedicated connector. In the case of either configuration, selecting a non serial data input will enable the 1086 to decode commands over the RS-232 port. If it is necessary to decode commands over the RS-422 port, please contact EPC Labs.

A2.2.1 SERIAL INTERFACE SELECTION

Serial interface selection is accomplished by setting the appropriate interface (RS-232 or RS-422) for data input or selecting a non serial interface for data input, thus enabling the RS-232 port for command decoding. The transmission speed must then be set in the “BAUD” field. The serial interfaces support baud rates up to 115200. The serial data format is always eight data bits, one stop bit, and no parity (8,l,n) and a null modem is required to connect the host (DTE) to the recorder.

A2.2.2 RS-232 CONNECTIONS

Use of the RS-232 interface requires a null modem. A null modem is a device the crosses the data and handshaking lines on a serial cable to make a target computer emulate a modem. Null modems can be purchased from most computer hardware vendors for a small cost. The devices come in many pin configurations. The exact configuration required will vary based on the equipment sending the serial data. One side of the null modem must be interfaced to the nine pin "D" connector found on the GSP. The pin-outs of this connector are as follows:

PIN #	SIGNAL NAME
1	DCD
2	RX
3	TX
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI

TABLE A2-1: RS-232 PIN ASSIGNMENTS

A2.2.3 RS-422 CONNECTIONS

The RS-422 interface is generally employed when the cable being used to connect the target to host is very long. Transmission lines in this standard are said to be "differential". Each signal line has a return line that will always be in the opposite state of the signal. When the two wires are grouped together in a twisted pair, noise is greatly reduced and transmission characteristics are improved. The pin assignments for the 9 pin RS-422 "D" connector are as follows:

PIN #	SIGNAL NAME
I	TX-
2	TX+
3	RX+
4	RX-
5	GND
6	RTS-
7	RTS+
8	CTS+
9	CTS-

TABLE A2-2: RS-422 PIN ASSIGNMENTS

A2.2.4 TESTING A SERIAL LINK

The easiest way to test the serial link is to interface a PC to the RS-232 port (with a null modem) and run a terminal emulator program (such as "Procomm"). You could also interface a proper terminal (UNIX type "TTY" terminal) to the printer. With the connections in accordance with the previous paragraphs, try typing the same command example given in paragraph A2.1 (the feed command). The results should be the same.

A2.3 COMMAND PROTOCOL

The GSP decodes and interprets its own command language. This language is said to be the "command protocol" and is very simple to understand. As outlined in earlier paragraphs, commands sent to the printer are sent over an interface one ASCII character at a time and then terminated with a carriage return, line feed, or both. In the case of entering commands from a keyboard (terminal emulator or direct), this usually means pressing the [ENTER] key after typing the command string. A command string has the following syntax:

HEADER ARG1 ARG2 ... ARG*n*(CR/LF)

The individual components of the command string are defined as follows:

* Header: The header is three or more characters that describe the command being implemented. It is only necessary to send the first three characters. For example, in building a command string to change the contrast setting, the header could be "CON", "CONTR" or “CONTRAST”. One or more spaces (", DEC 32, 0x20) is used to delimit the header from the remaining characters in the command string.

* arg1 arg2 ... ARGN: arguments are one or more strings of text, separated by one or more spaces (",DEC32, 0x20), that define a new value or setting for the command to be implemented. To build on the header example, the following command would set the contrast level at +7%:

CON 7(CR/LF)

*CR/LF terminator: each command string sent should always be ended with a carriage return character ('\r', DEC 13, 0X0D), a line feed character ('\n', DEC 1 0, 0X0A), or both.

A2.3.1 COMMAND SET

The following table lists the entire command set available with the GSP-1086. Examples are given to clarify commands. Where the header and arguments are defined, the letters in parenthesis are optional. Any functions not covered in the main manual will be described in detail below.

FUNCTION: AUTO-EVENT

HEADER:AUT(OEVENT)
ARGUMENTS: OFF, 1 to 60

DESCRIPTION: The auto-event command is used to set the interval at which the current event will be triggered. In the example below, the interval is set to 20 minutes.

EXAMPLE: AUT 20

FUNCTION: BACKGROUND

HEADER: BAC(KGROUND)
ARGUMENTS: WHITE, DATA

DESCRIPTION: The background command determines if messages are printed on top of data or if the message is printed in a whited-out window. In the example below, messages are set to print on top of data.

EXAMPLE: BAC DATA

FUNCTION: CONTRAST

HEADER: CON
ARGUMENTS: -30 to +40

DESCRIPTION: The contrast command is used to set the intensity of the display. In the example below, the intensity is set 5% lower than the calibrated average.

EXAMPLE: CON-5

FUNCTION: DATA TYPE (DTYPE)

HEADER: DTY(PE)
ARGUMENTS: 4BIT, 5BIT, 6BIT, 7B[T, 8BIT

DESCRIPTION: The data type command is used to select what numeric range gray scale data will be interpreted over. In the example below, the GSP is configured to use a byte value of 63 to represent black on the paper. The largest six bit binary number translates to 63 decimal (0x3f). In this case, all possible gray levels, from white to black would fall between 0 and 63. A data type of 8bit would allow differentiation between 256 levels (o to 255). The shade value should not be set higher than the amount of bits being printed (ex. Shades 256 and dtype=4bit is an illegal condition). Generally speaking, "8bit" should be selected when printing analog data. This is because the A/D converter on the analog interface board is an eight bit device.

EXAMPLE: DTY 6BIT

FUNCTION: SET DATE

HEADER: DAT(E)
ARGUMENTS: XX/XX/XX (WHERE'X's REPRESENT VALID DATE)

DESCRIPTION: sending the date command sets the GSP's internal date clock to the date specified in the argument. In the example below, the GSP's current date would be set to august 3rd, 1995.

EXAMPLE: DAT 08/03/95

FUNCTION: PRINT AN EVENT

HEADER:EVE(NT)
ARGUMENTS: DASHED, SOLID, TICK, MESSAGE

DESCRIPTION: Sending an event command prints the specified event type and also sets that type as the current event type. In the example below, a dashed line would be printed across the paper. Scrolling to the event menu would also reveal that the current event type had been set to "DASHED".

EXAMPLE: EVE DASHED

FUNCTION: PAPER FEED

HEADER: FEE(D)
ARGUMENTS: 0.01 to 30.00 (INCHES)

DESCRIPTION: The FEED command causes the paper to be advanced arg number of inches. In the example below, printing would stop and paper would be advanced 5.58 inches.

EXAMPLE: FEE 5.58

FUNCTION: FILL MESSAGE BUFFER (FILLBUFF)

HEADER: FIL(LBUFF)
ARGUMENTS: ARG1: 1, 2,3
ARG2: *DESIRED TEXT STRING*

DESCRIPTION: The FILLBUFF command fills one of three user definable buffers (arg1) with a message string of up to 128 characters (arg2). In the example below, buffer #3 would be filled with the ASCII string "look out Marino, QB sack!". If the command "MES 3" were to then be sent, the string would be printed on the paper.

EXAMPLE: FILL 3 LOOK OUT MARINO, QB SACK!

FUNCTION: LINE REPEAT

HEADER:REP(EAT)
ARGUMENTS: 1 to 5

DESCRIPTION: The line scale, or repeat, command is responsible for controlling how many times a line of data will be printed. In the example below, the GSP would be set to print each line of data twice.

EXAMPLE: REP 2

FUNCTION: IMAGE POLARITY (INVERSE)

HEADER: INV(ERSE)
ARGUMENTS: POSITIVE, NEGATIVE

DESCRIPTION: The inverse function is used to compliment each data byte received prior to printing its corresponding pixel value. In the example below, the GSP would print the inverse of the image data -- similar to the “NEGATIVE” of a black and white photo.

EXAMPLE: INV NEGATIVE

FUNCTION: LINES PER INCH (LPI)

HEADER: LPI
ARGUMENTS: 75, 80, 100, 120, 150, 200, 240, 300, EXT

DESCRIPTION: The LPI command is used to set the line pitch for each successive scan line of data. After executing the command in the example below, the GSP would print each line 0.00667 inches apart (1/150). The "EXT" setting is used to drive the chart with an independent clock.

EXAMPLE: LPI 150

FUNCTION: MESSAGE LOCATION (MARGIN)

HEADER: MAR(GIN)
ARGUMENTS: 0. 00 to 1 0. 00

DESCRIPTION: The margin command is used to position text messages arg inches from the bottom margin of the paper. Executing the command in the example below would cause the GSP to print the next message starting at the very middle of the paper.

EXAMPLE: MAR 5.05

FUNCTION: MEDIA (PAPER OR FILM)

HEADER: MED(IA)
ARGUMENTS: PAPER, FILM

DESCRIPTION: The media command is used to configure the GSP for the type of paper it is printing on; thermal paper or high grade plastic film. In the example below, the GSP would be configured for film.

EXAMPLE: MED FILM

FUNCTION: PRINT MESSAGE STRING (MSG)

HEADER: MES(SAGE)
ARGUMENTS: 1, 2, 3, 4, 5, 6, 7, or ANY TEXT STRING

DESCRIPTION: The message command is used to print either a pre-defined message (arg1 = 1 to 7), or a text string entered at the time the command is sent (arg1=ASCIItextstring). In example

one below, the GSP would print out user buffer #2 (filled with the FILLBUFF command). Example two would cause the unit to print the text string "hello Larry" on the record using the current attributes (size, background, and margin). Any text string can be entered, provided it does not begin with the character that is a number (0-9).

EXAMPLES: 1. MES 2
2. MES HELLO LARRY

FUNCTION: SCALE LINES

HEADER: SCA(LE LINES)
ARGUMENTS: 5, 10, 20, OFF

DESCRIPTION:

The scale lines command is used to turn various number of scale lines on and off. In the example below, the GSP would print 20 equally spaced lines along the time axis.

EXAMPLE: SCA 20

FUNCTION: MESSAGE CHARACTER SIZE

HEADER: SIZ(E)
ARGUMENTS: 1, 2,3,4,5

DESCRIPTION: The size command is used to set the scale of the printed alphanumerics. In the example below, messages would be printed at three times the smallest possible size (width and height).

EXAMPLE: SIZ 3

FUNCTION: SHADES-OF-GRAY

HEADER: SHA(DES)
ARGUMENTS: 008,016,032,064,128,256

DESCRIPTION: Shades of gray to print can be selected remotely by sending the shades command. The argument to the shades command must be three characters long (i.e. "SHADES 8" is illegal, "SHADES 008" is proper). In the example below, the GSP would be set so that each pixel would be capable of printing 16 different intensities.

EXAMPLE: SHA 016

FUNCTION: SET TIME OF DAY

HEADER: TIM(E)
ARGUMENTS: XX:XX:XX (WHERE 'X's REPRESENT VALID 24 HR TIME)

DESCRIPTION: The GSP's real time clock can be set using the time command. The argument should be in 24 hour format. In the example below, the clock would be set to 2:22:22 P.M.

EXAMPLE: TIM 14:22:22

FUNCTION: IMAGE WIDTH

HEADER: IMA(AGEWIDTH)
ARGUMENTS: 1 to 2048

DESCRIPTION: The image width command is used to set the width of the printed image in pixels. Primarily, this command is used to set the point where digital data will synchronize at. For instance, if a digital image has a width of 640 pixels, the image width would need to be set to 640 in order for the picture to print out properly. In the example below, the image width would be set for 1024 pixels (about five inches).

EXAMPLE: IMA 1024

FUNCTION: SCAN RATE

HEADER: SCN
ARGUMENTS: 0.005 - 3.000

DESCRIPTION: The scan rate command is used to set the period of time in which 2048 samples of analog data (one scan line) will be collected. In the example below, each printed line of data would be collected in 31 ms, that is the width of the display would represent 31 ms of data. For a valid setting, the scan rate + the delay period should never be greater than the key period.

EXAMPLE: SCN 0.031

FUNCTION: KEY RATE

HEADER: KEY
ARGUMENTS: 0.015 - 3.000

DESCRIPTION: The key rate command is used to set the frequency of key pulses generated on the “KEY OUT” jack when the recorder is in "internal" trigger mode. The polarity of the key pulse is controlled with the "KPOL" command. In the example below, a 62.5 us wide, TTL pulse would be generated every 1/16 seconds. For a valid setting, the scan rate + the delay period should never be greater than the key period.

EXAMPLE: KEY 0.062

FUNCTION: DELAY PERIOD

HEADER: DEL(AY)
ARGUMENTS: 0.000 - 0.500

DESCRIPTION: The delay command is used to set a delay between the zero pulse (internal or external) and the first sample of data (pixel 0). This feature is useful in deep water seismic applications where the water column would normally take up much of the scan. In the example below, 10 ms of data would be delayed off the record. For a valid setting, the scan rate +the delay period should never be greater than the key period.

EXAMPLE: DEL 0.010

FUNCTION: KEY POLARITY

HEADER: KPO(L)
ARGUMENTS: POS(ITIVE) or NEG(ATIVE)

DESCRIPTION: The key polarity command is used to set the polarity of outgoing key pulses. A key pulse can either be high active (active at TTL high, idle at TTL low) or low active (active at TTL low, idle at TTL high). In the example below, the GSP would generate a positive going TTL pulse every key period.

EXAMPLE: KPO NEGATIVE

FUNCTION: EXTERNAL TRIGGER SLOPE

HEADER: SLO(PE)
ARGUMENTS: RIS(ING) or FAL(LING)

DESCRIPTION: The trigger slope command is used to set which edge of an external key pulse will trigger the start of a scan. In the example below, the falling edge of an incoming key pulse would start a sweep.

EXAMPLE: SLO FALLING

FUNCTION: SIGNAL SELECT (CHANNEL A/B)

HEADER: SIG(NAL)
ARGUMENTS: SIN(GLE) or DUA(L)

DESCRIPTION: The signal command is used to set how many analog traces will be displayed, one or two. In single signal mode, the entire display is allocated to the signal present on the "CHANNEL A" BNC. In dual channel mode, the display is split with channel A on the bottom and channel B in reverse sweep on top. Typically, two channel mode is used for center-out side scan applications. In the example below, the GSP would be set up to print side scan type data.

EXAMPLE: SIG DUAL

-- ---

FUNCTION: SWEEP DIRECTION

HEADER: SWE(EP)
ARGUMENTS: FOR(WARD) or REV(ERSE)

DESCRIPTION: The sweep direction command is used to switch the orientation of single channel data. When set to "FORWARD", the scan line will be displayed with "TIME ZERO" toward the top of the printout (near control panel). In reverse sweep mode, the first pixel of a scan line will print in the bottom margin, near the I/O panel, the latter of the two cases is represented by the example below.

EXAMPLE: SWE REVERSE

FUNCTION: TRIGGER SELECTION

HEADER: TRI(GGER)
ARGUMENTS: INT(ERNAL) or EXT(ERNAL)

DESCRIPTION: The trigger command is used to select the source of the zero pulse for each scan line. When "INTERNAL" is selected, the beginning of each scan cycle will be started by the GSP's own internal key pulse (set in the “KEY RATE” field). This TTL pulse will be output on the “KEY OUT” BNC jack at the bottom of the unit. A selection of "EXTERNAL" will cause the GSP to wait for a TTL level pulse on its “TRIG IN” BNC to start each sweep. The key polarity and trigger slope functions effect these pulses, respectively. In the example below, the GSP would be configured to wait for an external TTL pulse (edge sensitive) to start a scan. <u>WHEN USING INTERNAL TRIGGER, THE "TRIG SLOPE" FIELD MUST BE SET TO RISING OR THE RECORDER WILL NOT PRINT</u>.

EXAMPLE: TRI EXTERNAL

FUNCTION: SCALE LINE INTENSITY

HEADER: SCL(INE)
ARGUMENTS: 25%,50%,75%,100(%)

DESCRIPTION: The scale line intensity command can be used to set the contrast of the scale lines as a percentage of black. In the example below, scale lines would be printed at a mid-level gray.

EXAMPLE: SCL50%

FUNCTION: VIDEO SOURCE

HEADER: INP(UT)

ARGUMENTS: S-V(IDEO, B/W(COMPOSITE)

DESCRIPTION: The video input command is used to set which video source is sampled, s-video or black and white composite. S-video uses the 4 pin mini-din connector on the front panel, and the ban composite uses the RCA type connector. In the example below, the 1086 would be configured to print video data coming from a standard, black and white composite source.

EXAMPLE: SCL 50%

FUNCTION: VIDEO BRIGHTNESS

HEADER: BRI(GHTNESS)
ARGUMENTS: -100 TO +100

DESCRIPTION: The video brightness command is used to lighten or darken the color in a captured video image. In the example below, video brightness would be set to a nominal, mid-range level.

EXAMPLE: BRIO

FUNCTION: VIDEO CONTRAST

HEADER: INT(ENSITY)
ARGUMENTS: -100 TO +100

DESCRIPTION: The video contrast command is used to set the distinction between light and dark areas of a video image. In the example below, video contrast would be expanded 10% above normal range.

EXAMPLE: INT 10

FUNCTION: VIDEO RESOLUTION

HEADER: RES(OLUTION)
ARGUMENTS: 512(x480), 102(4x960), 153(6x1440), 204(8x1920), 480(x5l2r), 960(xl024r), 144(0x1536r), 192(0x2048r)

DESCRIPTION: The video resolution command is used to determine the magnification and orientation of the printed video image. The core video image is always 512 pixels wide by 480 lines high. The image can be magnified up to four times (x4) and rotated to 0 or 90 degrees. Arguments ending with an "r" mean that the image will be rotated 90 degrees. In the example below, a captured video image would be printed at twice its original size and rotated 90 degrees. The "SWEEP DIR" setting will determine which side of the paper the image is printed on and whether it is printed mirror image or not.

EXAMPLE: RES 960

A3.0 DATA INTERFACE

: The GSP-1086 printer can collect and print data from a variety of possible interfaces

* RS-232 SERIAL I/O (1200-115,200 BAUD, 8, N, 1)
* RS-422 SERIAL I/O (1200-115,200 BAUD, 8, N, 1)
* DUAL CHANNEL ANALOG
* B/\/V COMPOSITE VIDEO -- PAL or NTSC
* S-VIDEO STANDARD VIDEO -- PAL or NTSC
* CENTRONICS COMPATIBLE PARALLEL

In general, the analog interface is the primary data input. Selection of which interface to use is accomplished by toggling the options in the "DATA INPUT" field on the control panel. If RS-232 or RS-422 is selected, the 1086 will wait for 2048 (or "WIDTH") bytes of data to arrive over the active serial port before printing a line. The range of the data sent should be compatible with the setting of the "DATA TYPE" field. For instance, if the highest byte value of the data being sent is decimal 63 (Ox3F), data type should be set to "6bit". This will insure that a byte of 63 will print black, 30 will print mid-level gray, etc. If for some reason, serial data gets out of synch, the serial buffer can be cleared by toggling the data input field or the baud rate field. It is important to note, the serial data prints very slow. The fastest baud rate (1 15.2kbs) equates to about 200 ms per line. For this reason, contrast may need to be adjusted to a large value to achieve proper intensity. Use of the video interfaces is discussed later in this appendix.

A4.0 ANALOG INTERFACE SPECIFICATIONS

The GSP-1086 is equipped with a dual channel analog interface. Both channels operate on a common scan clock with the assumption that two channel applications will be predominately for side scan sonar. As stated before, channel B runs in reverse sweep mode on the top half of the record -providing a "center-out" image. Analog controls and electrical specifications are provided below.

A4.1 ANALOG CONTROLS

The various controls to manipulate the analog input can be classified into two categories -analog and digital. The digitally implemented controls are SCAN RATE, KEY RATE, DELAY PERIOD, KEY POLARITY, TRIGGER SLOPE, SWEEP DIRECTION, CHANNEL SELECTION, and TRIGGER SOURCE. These controls are discussed in detail in the command set (paragraph a2.3.1). **IMPORTANT: TO PRINT THE FULL RANGE THAT THE 1086's A/D CONVERTERS ARE CAPABLE OF PRODUCING, THE "DATA TYPE" FIELD SHOULD BE SET TO "8BIT". IF DATA APPEARS TO BE WASHED OUT OR HEAVY, CYCLE THROUGH THE "DATA TYPE" SETTINGS AND SET THE FIELD TO "8BIT".**

The analog controls are those real-time controls found near the signal input. Their functions are as described as follows:

1. GAIN -- THIS 20K OHM, 10 TURN, POTENTIOMETER IS USED TO SET THE AMPLIFICATION ON THE ANALOG SIGNAL. DEPENDING ON THE NATURE OF THE RAW SIGNAL, AND THE NUMBER OF SHADES SELECTED TO PRINT, THE GAIN CONTROL WILL HAVE DIFFERENT EFFECTS. IN GENERAL,

THE CONTROL CAN BE USED TO INCREASE OR DECREASE THE DYNAMIC RANGE OF THE DATA BEING PRINTED.

2. POLARITY -- NOT TO BE CONFUSED WITH "KEY POLARITY", THE SIGNAL POLARITY SWITCH IS USED TO SELECT WHICH PORTIONS OF THE ANALOG WAVE FORM TO PRINT. A SELECTION OF "+" WILL CAUSE THE 1086 TO ONLY PRINT THAT PORTION OF THE SIGNAL THAT IS ABOVE SIGNAL GROUND. CONVERSELY, A "-" SETTING WILL CAUSE THE UNIT TO PRINT ONLY NEGATIVE GOING SIGNALS. THE MIDDLE POSITION "+/-" CAUSES THE GSP TO PRINT ALL THE INFORMATION IN THE SIGNAL.

3. THRESHOLD -- THE THRESHOLD POTENTIOMETER IS USED TO OFFSET THE ENTIRE INPUT SIGNAL ABOUT GROUND. GENERALLY, THIS CONTROL IS INCREASED TO ADD A NEGATIVE DC OFFSET. THIS HELPS TO ELIMINATE SMALL COMPONENTS OF NOISE PRESENT IN THE SIGNAL.

A4.2 EXTERNAL EVENT MARK:

An external event mark input is provided on the I/O panel for using an external signal to trigger events on the recorder. There is a low pass filter on the input to de-bounce manual switch closures which makes the minimum pulse width roughly one millisecond (1.0 ms). In non-video modes, an external event will trigger whatever type of event is set up in the "event type" field. When the data source is video, an external trigger will cause a frame of video to be captured and printed.

A4.3 EXTERNAL CHART DRIVE:

Although the 1086 offers a wide range of chart speeds (LPI), it is occasionally desirable to advance the chart using an independent and variable clock. External chart drive is accomplished by connecting the external drive clock to the "EXT chart" BNC on the I/O panel and selecting "EXT" under the LPI field. Great care must be taken when using this feature. Using clock frequencies greater than 1.2 kHz will cause erratic chart drive and may lead to printing problems. For every clock pulse the 1086 receives, thepaperwillbeadvancedl/1200thofaninch. The 1086 will not print a line of data until at least four clock pulses have been counted. This yields a minimum chart speed of about 300 lines per inch. Because the counting of these clocks is based on clock edges, the minimum count will usually be reached despite clock frequency. This allows a safe count to be reached while overdriving the stepper motor module. The end result is choppy, dark lines. If this phenomenon is present, a lower frequency should be used.

A4.4 ELECTRICAL CHARACTERISTICS

The following specifications describe all pertinent electrical information associated with the analog interface board.

INTERNAL KEY PULSE (KEY OUT):

TTL PULSE: 62.5 uS WIDE, POLARITY SELECTABLE. 50 OHM BNC INTER-CONNECT.

EXTERNAL TRIGGER INPUT (TRIG IN):

TTLINPUT: EDGE SENSITIVE, SENSE (RISING OR FALLING) SELECTABLE.
50 OHM BNC INTER-CONNECT.

ANALOG SIGNAL INPUT (TRIG IN):

INPUT VOLTAGE: 0V-10V (150 mV MINIMUM FOR FULL SCALE).
BANDWIDTH: DC - 100 kHz, -3 dB @ V IN = 1V.
IMPEDANCE: 2k OHMS, 50 OHM BNC INTER-CONNECT.

EXTERNAL MARK INPUT (EXT MARK):
TTLINPUT: EDGE SENSITIVE, CONTACT CLOSURE. 50 OHM BNC INTER-CONNECT.

PULSE WIDTH: 1.0 ms MINIMUM PULSE WIDTH.
LATENCY: 10-100ms DEPENDING ON GRAY LEVELS.

EXTERNAL CHART INPUT (EXT MARK):

TTLINPUT: VARIABLE SPEED CLOCK DRIVE. 50 OHM BNC INTER-CONNECT.

BANDWIDTH: 1.2kHz, MAXIMUM.

PULSE WIDTH: 100us MINIMUM.

A5.0 VIDEO INTERFACE SPECIFICATIONS

The video frame grabber board inside the GSP-1086 is configured for the "PAL" video standard. As opposed to its American counterpart, NTSC (RS-170), the pal standard governs most European TVs, cameras, and video tape decks. Generally speaking, these devices synchronize vertically at 50 Hz and horizontally at 15 kHz.

A5.1 BLACK AND WHITE COMPOSITE VIDEO

Selecting "COMP BI\IV' l n the "VID INPUT" field will cause the 1086 to look for video signals on the RCA jack labeled "composite". The termination is 75 ohms. If the video cable is going to be connected to other equipment, and the 1086 is not the terminating point, a jumper must be set on the video board. Contact EPC Labs for assistance in this case.

A5.2 S-VIDEO

The S-video interface is accessed through the four pin "mini-din" circular connector labeled "S-video". S-video signals are cleaner than composite because the color information and the intensity information are separated into two distinct signals. Composite video combines both of these signals onto one wire which tends to produce more artifacts in the image. At the time this manual is being written, S-video is just becoming popular in many camcorder devices. It provides a much cleaner and crisper image than the standard composite output.

A5.3 CAPTURING AN IMAGE

Capturing a video image involves the following steps:

1. **SET UP THE RECORDER AND TEST TO SEE THAT IT IS PRINTING PROPERLY.**

2. **CONNECT YOUR VIDEO SOURCE TO THE APPROPRIATE JACK.**

3. **SET DATA INPUT TO "VIDEO", SWEEP DIRECTION TO REVERSE", INVERSE TO "NEGATIVE", DATA TYPE TO "8BIT", VIDEO RESOLUTION TO "512x480", CONTRAST TO "0%", AND SHADES TO "32".**

4. **SET VIDEO INPUT TO "S-VIDEO" OR "COMP BIW" -WHICHEVER YOU ARE USING.**

5. **WITH VIDEO DATA PRESENT, EITHER PRESS THE "ENTER" BUTTON ON THE CONTROL PANEL OR PROVIDE A CONTACT CLOSURE OVER THE**

"EXT MARK" BNC ON THE I/O PANEL. IF EVERYTHING IS PROPER, VIDEO DATA WILL BEGIN TO PRINT.

.USE THE INTENSITY, BRIGHTNESS, SWEEP DIRECTION, AND RESOLUTION FUNCTIONS TO MANIPULATE THE IMAGE TO YOUR LIKING. THE PRINTING OF AN IMAGE MAY BE TERMINATED AT ANY TIME BY PRESSING ANY BUTTON ON THE CONTROL PANEL.

A5.3.1 VIDEO CAPTURE ERRORS:

Two possible errors can occur while trying to capture a video image. In both cases, the 1086 will beep once and display an error message on the left LCD. If a memory error is displayed, something may be wrong with the system memory. This problem should be reported to EPC. If a capture error is displayed, the video board was unable to lock onto a video signal. This may be because of a loose cable or the source equipment may not be producing video at that time. Some battery powered equipment automatically shuts down after a period of inactivity. Immediately after a capture error, the 1086 will print the contents of its buffer. This is usually the last image captured.

A5.4 MANIPULATING VIDEO IMAGES:

There are several recorder functions that can be used to modify or enhance video images. These commands are covered in the command set (paragraph: A.2.3.1). To gain a proper understanding of what the various video commands do, simply connect a video source and try different combinations.

A6.0 PARALLEL INTERFACE TIMING

The GSP-1086-0 is equipped with a centronics compatible, eight bit, parallel interface. The input bandwidth of the interface has been measured at over 200 kHz. The software running the GSP is unable to service data at this rate, however. The effective throughput is ultimately determined by shades of gray to print, the various levels of contrast that are set, and the equipment that is sending the data. Standard centronics handshaking signals are used to pace data transfers -- with a slight wrinkle. This variation is described below.

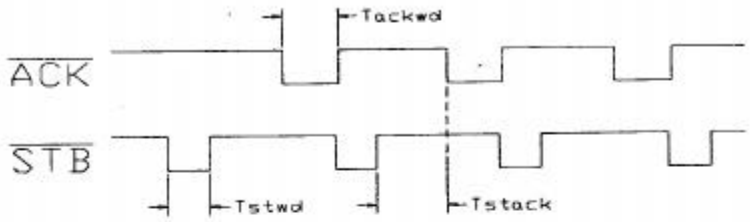
A6.1 HANDSHAKING

The standard centronics handshaking signals are implemented over three hardware lines -- /strobe, /acknowledge, and busy. In a host to target transfer, the host sets up a byte of data on the interface's eight data lines (pins 2-9) and, provided the printer is not busy, drives the strobe line low (pin 1). The rising edge of the incoming strobe pulse latches the data into the 1086-o's 2k x 9 FIFO (the ninth bit is unused). The rising edge of the strobe pulse also triggers a one shot that generates a low-active acknowledge pulse back to the host (pin 10).

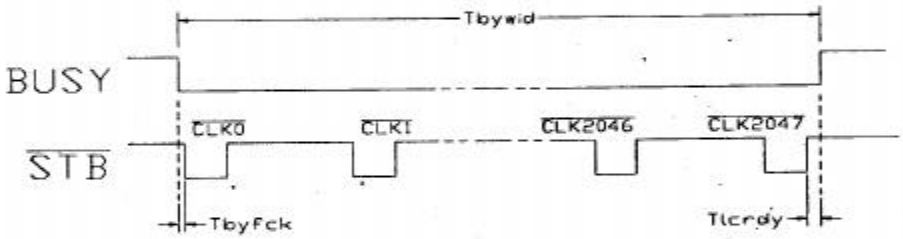
The difference arises in how the GSP uses its busy signal. In standard centronics timing, the busy line would also cycle high and then low on each transfer. Busy is generally the level that the host monitors to check the ready status of the printer. In the case of the 1086-0, busy does not cycle high until the FIFO is full of data (after the 2048th byte transfer). Busy will stay high until the GSP empties the FIFO and processes the line. This does not pose a problem for PCs using DOS "COPY" or the supplied driver code to initiate transfers. The only time problems may arise is if the host requires a busy cycle to trigger an interrupt or initiate another transfer. Generally the /ACK pulse is used for this sort of handshake. The FIFO can be clocked at a rate faster than any conventional computer programs could send data to it, so over clocking the circuit should not be an issue. "SELECT", "ERROR", "INIT", "PAPER END" and "AUTO FEED" are not implemented.

A6.2 TIMING DIAGRAMS

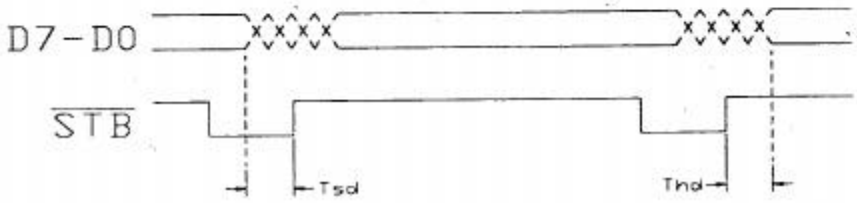
STROBE / ACKNOWLEDGE TIMING



STROBE / BUSY TIMING



DATA SETUP / WRITE TIMING



A7.0 PROGRAMMING EXAMPLE

Often times, system programmers are handed an EPC printer, with or without documentation, and told, "Write a driver for this". Usually this leads to several calls to the factory to gain the proper perspective on how to attack the task. EPC has found that a few programming examples go a long way towards getting equipment interfaced. The enclosed floppy disk contains some sample source code that EPC Labs wrote while testing the 1086-0. The program, which was compiled on the Borland 3.1 C/C++ product, is no frills in nature. It simply generates ascending tone levels on the GSP by sending different data values over the printer port on a standard PC. Feel free to distribute, modify, and experiment.