Eventide
the next step

INSTRUCTION MANUAL
FOR THE
EVENTIDE EXPRESSWAY[TM]

First Printing   1 June 1985
Second Printing August 1985: Fix typos, extend warranty term.
Third Printing August 1985; Incorporate data on RS-232 option.
Fourth Printing February 1986: Add tidbits about multiple plots.

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WHAT TO DO IF YOU HATE READING MANUALS

The Expressway can be complicated if you want it to be. Elsewhere in this
manual you will find out how to set default options with the internal switches,
theory of operation, and what all those blinking lights mean. Here you will
learn how to get started immediately. If you are lucky, you may never have
to read beyond this section.

THIS SECTION APPLIES IF:

1: You are using an HP desktop computer with a SINGLE PRINTER, SINGLE
   PLOTTER, or ONE OF EACH.

2: You are using the STANDARD HP default select code settings, i.e.,
   1 (701) for your printer, and 5 (705) for your plotter.

3: You are using an Expressway that incorporates only HP-IB connectors,
   and does not use the optional RS-232 port(s).

DO THE FOLLOWING:

1: RECONFIGURE YOUR HP-IB SETUP so that the computer and all peripherals
   other than the printer and plotter are connected to the rear panel
   connector labelled "PORT 0". As always, no more than three connectors
   should be stacked on any given socket.

2: Connect the printer via its own cable to PORT 2, and the plotter
   via its own cable to PORT 1. Note that this will require one more
   cable than you previously had in the system. It may be that this will
   require one more cable than you have anywhere. If this is the case,
   we (or HP) sell appropriate cables.

NOTES ON PHYSICAL PLACEMENT:

1: By now you will have noticed that you cannot lay the Expressway flat
   on the desk or table with those connectors attached. Given the total
   size of the device and the nature of horizontal spaces in general, we
   felt it was best to design the unit so that the cables protrude over
   the rear edge of the table. If this is impractical, you'll have to
   put it on top of something.

2: Do not completely surround the Expressway with other things. This
   will block ventilation, increase internal temperatures, and have a
   deleterious effect on reliability.

POWER CONNECTION:

1: The unit runs on 115 or 230V nominal, 50-60Hz. If your line voltage
   is consistently above 120/240V, or below 110/220V, or is subject to
   fluctuations or spikes, you should consider correcting and/or
   stabilizing it. You probably already know this.

2: The safety folks insist we tell you things like:

   There are no user serviceable parts inside. Don't open it or put
   your fingers or other objects inside.

Do not subject the unit to rain or moisture.

You probably already know this too.

POWERING UP THE SYSTEM:

1: The Expressway goes through an extensive self-test routine when it is
   turned on. This serves two purposes. It gives you confidence that
   the unit is working correctly, and it allows the plotter and printer
   to reach a state of readiness. This is required because the
   Expressway interrogates the plotter(s) to pass certain
   information on to the computer. Therefore:

2: MAKE SURE THAT THE PLOTTER AND PRINTER ARE POWERED ON BEFORE OR
   SIMULTANEOUSLY WITH THE EXPRESSWAY.

3: After turn-on, you will see a lot of blinking lights. Everything is
   OK if you see the following pattern (after a period of time determined
   by the memory option installed). (o is off, * is on.)

                        o o * o o o

                           o o

The system should now work as it always did, except faster.
If you encounter problems, you will have to read the manual. We
suggest that you start with the "LIMITATIONS" section, since this
tells you what you can't do that you might be trying.

Theory of Operation

The Eventide Expressway(TM) is a self contained, self powered buffer designed to enhance the apparent performance of Hewlett-Packard computers using certain HP-IB peripherals. It does this by permitting the computer to transmit data to these peripherals much faster than would otherwise be possible. Because of the nature of computer usage, it is difficult to "benchmark" the performance without knowing the specific application. We have logged improvements of essentially zero to literally hundreds of times.

This section explains how the buffer works, how to determine how much it can help in your application, and certain features, characteristics, and limitations of which you should be aware when using it.

HP-IB Transfers

HP computers typically connect to their peripherals via the IEEE-488 interface bus, otherwise known as "HP-IB" or "GP-IB" (General Purpose Interface Bus). These terms are used synonomously here. IEEE-488 is both a protocol and a physical interconnection bus. In order to send data over the bus, the protocol dictates that a TALKER and a LISTENER be present. In addition, the transfer is usually initialized by a third device, a CONTROLLER. A device can be a TALKER, LISTENER, or CONTROLLER, or any combination. (It cannot be a TALKER and LISTENER simultaneously.)

Although the bus has many additional capabilities, by far the most common use is to send data messages between the computer and its peripherals. For the many slower peripherals, e.g., printers and plotters, the most common use is for the computer to send messages TO the peripherals. Return traffic is virtually nonexistent. This is the case for which the Expressway was designed. Let's look at a typical data transfer scenario.

The computer wishes to send a data message to the printer, for the purpose of printing a few words on paper. The printer is connected to the computer's HP-IB, as is a plotter, a digitizer, and a disk drive. To send a data message to the printer, the computer does the following:

1: It issues an UNLISTEN command. This tells all the peripherals (including the printer) to pay no attention to data coming over the bus.

2: It issues a LISTEN <printer> command. The printer receives data at a specific HP-IB ADDRESS, which it and the computer agree to. (Normally this is address 1, as is the Expressway's default printer setting.)

3: It issues a TALK command to itself, so that it can send a message to the printer.

   All of the above is done with a bus control line known as ATN (attention) asserted. This tells all the peripherals that they are receiving CONTROL information. After the above sequence is complete, the HP-IB is said to be CONFIGURED for a transfer.

4: The computer drops the ATN line, in effect alerting the peripherals that data is now coming. Remember that the printer is now LISTENING, and no other devices are. Thus, any data message goes to the printer only.

5: The computer now sends the data to the printer, which prints it out.

In order to see how the Expressway can improve on the operation of the bus, we must examine the limitations of the above process.

LIMITATIONS OF THE BUS

The HP-IB is capable of high speeds. Typically, transfers can proceed at as much as 500KBytes/second, and even higher speeds are possible with certain precautions. Unfortunately, the speed is also limited by the peripherals.

Inherent in the bus' operation is the concept of the "handshake". Every time a byte of data is sent out from the computer, a handshake line is also asserted. When the byte is accepted by the peripheral, the handshake is completed, and the computer is allowed to send another byte. If the peripheral is not ready for another byte, the handshake is not completed, and the computer is prevented from continuing. This explanation ignores the "three wire handshake" which gives the bus many of its unique capabilities, but is irrelevant here.

If the peripheral doesn't handshake, the simple minded response of the computer is usually to wait until it does. If all the equipment is operating normally, there is rarely a long delay between handshakes. If a printer can accept, say, one line of data, but then must hold up further data while the line is being printed, data will be transferred in bursts with some milliseconds between the bursts. A typical printer operates at from 30 to 300 characters per second. The buffer can accept data at approximately 20K characters per second. IF all goes according to the oversimplified explanation above, this implies an improvement of 66 to 666 times. Before complicating the explanation, let's consider another limitation.

Remember that the bus uses only one set of cables to transfer all information. So, it's impossible to take advantage of the period of time that the peripheral holds up the handshake to send data to other peripherals. Trying to do so would in effect force two different voltages on the same piece of wire, a truly undesirable state of affairs. While it is theoretically possible to interleave data going to peripherals, this is difficult for a variety of reasons, the most obvious of which is that the computer would never know how near to being "full" a given peripheral is. Once it stops handshaking, dead time is forced on the system.

Thus, if we have data to send to the printer, and a graph to plot on a plotter, we must do these tasks sequentially. If each takes ten minutes, both tasks will take twenty minutes. During those twenty minutes, the human being in the loop is wasting time. And the computer is using its vast powers monitoring a handshake line.

We are now prepared to consider how the Expressway obviates all this waiting. Earlier we "benchmarked" the performance increase of the printer at 66 to 666 times. Probably the most important specification of a printer is its speed in characters per second. Simple division gives the performance improvement. Plotters are more difficult to characterize. While HP gives you the pen acceleration and ultimate speed, you are the one who determines the line length. Also, in many applications, pen velocity is restricted due to pen and media considerations. It is entirely possible to have conditions in which the plotter can accept an average of only 5 to 10 bytes per second, giving performance improvements on the order of several thousand.

The first key to performance improvement is the buffer's storage capability. With up to two megabytes of memory, it can store a print file as long as a full length novel, or a plot of a complete subdivision. In ordinary circumstances, the computer will be able to send all its data to the buffer at its maximum

rate. The second key is the two port output of the buffer. Because the buffer has two sets of cables, the conflict alluded to earlier doesn't exist. Even if one peripheral is refusing data, the second can be receiving it.

What this all adds up to is: You can use your computer, printer, and plotter simultaneously, and full time. In fact, under "worst case" conditions, adding the Expressway to your computer system can be equivalent to purchasing two complete, additional computer systems, one with a printer, and one with a plotter.

This is a rosy picture indeed, and is actually sometimes true. We have tested the buffer with the H-P EGS200 graphics package, and were delighted to discover that the user rarely had to wait more than a minute or so for the screen to go live, after dumping the plot to the buffer. When a highly paid engineer is sitting and waiting, one can appreciate the advantages of buffered plotters. But, before you go and buy an Expressway for every computer you own, consider some limitations.

LIMITATIONS OF THE EXPRESSWAY

1: Computer speed. In most applications, the computer is vastly faster than slow peripherals like printers and plotters. THIS IS NOT ALWAYS SO! If your printing involves lots of calculations per line of output, the Expressway may buy you no speed increase at all. Most printers can accept from a line to a thousand or so characters at high speed. If your calculations only generate a few lines per second, a buffer won't help.

This applies even more to plotters. Consider two extremes. Drawing a graph point by point, with closely spaced points and lots of calculation per point, won't tax the plotter. In fact, it will spend most of its time waiting for data rather than refusing it. At the other extreme, you have a large area to fill with a thin pen. This is one of the most time consuming plotter operations, and requires the least calculation. You'll be praising your Expressway to the heavens.

2: Serial data transmission. The buffer is by nature a serial device. Except under very limited conditions, only one-way data transfer is possible. Its use is therefore restricted to devices that are inherently one-way, or are being used in this mode. Printers are usually one way. Plotters are normally one way, with two exceptions. The first is during setup, when the program will sometimes ask for limits to be set, or interrogate the plotter to find out its type and capabilities. The second is when a digitize request is sent. To alleviate the first problem, the Expressway has routines which interrogate the plotter (when the plotter switch is set on the port card, see "setup".) This information is then passed on request to the program. In effect, the program believes it has direct access to the plotter for these commands. (See list in Appendix.) Unfortunately, there is no way to handle requests in a stream of outgoing data. To do so would require the output process to stop until the plotter caught up with the input, which violates the entire concept of the Expressway. If your software does this, it must be modified.

3: For similar reasons, it is unlikely that it can be used with other equipment (data loggers, test equipment) which frequently require two-way communication on the bus.

4: The Expressway can accept data at about 20Kbytes/second. If your peripherals can accept data at an average rate approaching this, the unit will gain you little in terms of performance.

WHAT GOES ON INSIDE

The Expressway is a computer in its own right. It uses a Motorola 6809 pseudo-16bit processor as its CPU, and has its operating program in an EPROM of up to 32K by 8 bits. It has, depending on options, from 256K to 2Megabytes of RAM. Of this, 16K is reserved for the CPU, and the balance is used to store two data queues in blocks of 256bytes. Each block is tagged as to which peripheral it belongs. In this way, memory is divided efficiently between the two ports regardless of how much data is available for each peripheral.

The computer is connected to the PORT 0 circuit board. Although all port boards are physically identical, they are configured by software to operate as described below. The peripherals are connected to ports 1 and 2, whose HP-IB addresses are determined by the settings of the address switches.

When power is applied to the Expressway, the CPU reads the address switches and configures PORT 0 to be a LISTENER and TALKER on these addresses. It also configures ports 1 and 2 to be controllers, so that they can configure the HP-IB and send data messages to the peripherals. The effect of this is to make the computer believe, with limitations, that it is still connected to peripherals at their respective addresses. (Additional peripherals connected to the computer, either at the computer or piggy-backed on the PORT 0 connector are not affected, and operate normally.)

If either PORT 1 or PORT 2 is configured to be connected to a plotter (see Setup), the Expressway, acting as CONTROLLER, takes certain actions. These are detailed in Appendix 1, and consist primarily of asking the plotter questions such as its model number and capabilities. These are relayed to the computer upon request. (This is why it is necessary to power up the plotter before the Expressway. If the plotter is OFF, it cannot respond to the interrogation, and later on the computer will not get the data it's expecting.)

Power is provided by a linear supply generating 5volts for the TTL logic power, and plus and minus 8 volts (unregulated) for the optional RS232 board. It can operate on 115 or 230V nominal, 50-60Hz, depending upon the setting of the rear panel voltage switch.

There are no operating controls, but the front panel has 8 lights which reveal a lot to the cognoscenti. When power is applied, the unit goes through a selftest routine. This is described in Appendix 3. Self test normally determines if the LEDs, CPU, RAM and ROM are working correctly. It can also determine if the port boards are functioning by use of appropriate HP-IB cables. In normal operation, (i.e., after self test is complete), these lights show the status of the Expressway as follows:

PORT 0 ACTIVE: (green)   When ON, means that Expressway has been addressed.
PORT 0 FULL: (red)   When ON, means that the buffer memory is full.
PORT 1 ACTIVE: (green)   When ON, means that the peripheral attached to port
                          1 is addressed to talk or listen.
PORT 1 QUEUE: (yellow)   When ON, means that there are at least 256 bytes of
                          data waiting to be sent to the port 1 peripheral.
PORT 2 ACTIVE: (green)   When ON, means that the peripheral attached to port
                          2 is addressed to talk or listen.
PORT 2 QUEUE: (yellow)   When ON, means that there are at least 256 bytes of
                          data waiting to be sent to the port 2 peripheral.

TEST: (green)   Indicates that selftest is in progress.
ERROR: (red)   When ON, indicates that selftest has found an error.

If either TEST or ERROR is on, the other lights have meanings different from
those listed above.

Most of this manual is written for the person planning to USE the Expressway. This section is written for the PROGRAMMER. It is a list of hints and kinks, do's and don't's, and suggestions on how to get the most efficient usage from the unit. If you are using a prepackaged program, this information may well be useless to you and can be skipped with impunity.

COMPUTER vs PLOTTER SPEED:

One of the interesting things we discovered during benchmarking was that some computer operations were slower than we thought. When sending complex fonts to a plotter from one of the slower computers (Series 80, 9845 slow processor), the Expressway didn't help as much as we thought it would. Apparently, when drawing complex characters, the time it takes to compute the end points of the very short vectors used is comparable to the time it takes to draw them. Without the Expressway, there is no incentive to speed up this process, since it doesn't really matter whether the computer is computing or waiting. With the Expressway, there is an incentive to use the computer more efficiently.

There are many ways to do this, perhaps as many as there are programmers. Some suggestions are:

1: Use assembly language or binary subroutines. Most plotting routines can benefit from integer arithmetic, since plot resolution rarely exceeds 65000 points.

2: Use precomputed tables whenever possible. This is especially helpful when you use trigonometric functions to compute the direction of short lines. Trig functions are typically the slowest to be computed.

3: Don't waste "waiting for input" time. Use keyboard interrupt routines when collecting data from the operator, and use the rest of the time to get a head start on generating information (or tables) for the plot.

4: Use the built-in intelligence of some HP-GL plotters. For instance, when drawing slanted characters, let the plotter compute the lines.

PERIPHERAL USAGE:

Although it is customary (and correct) to be primarily concerned with the efficiency of the computer and its operator, the decreasing price of computers vs. the increasing cost of peripherals makes it desirable to keep them humming along too. Because the Expressway can drive a printer and plotter simultaneously, consider a strategy that alternates data streams.
For instance, let's say you've generated a long plot, one that will take 4 hours to complete. While the Expressway is a big timesaver, it is not instantaneous. It may require from a couple of minutes to an hour to send this four hour plot to the Expressway. Meanwhile the printer is idle.
Use the intelligent queueing feature of the Expressway by interrupting the stream of plotter data and sending your print file. Immediately, the printer will begin to operate, while the plotter is digesting its, say, first hour's worth of information. Then when you are through with the printer information, continue the plotter data. Both peripherals will perform their jobs uninterruptedly.

IMPROVING PLOT QUALITY:

Perhaps the easiest way to improve the quality of many plots is to slow down

the pen! Of course, this is also the easiest way to eat up time. Now that you have the Expressway, consider using pen velocity commands to make your output look better. The actual velocity to use is a tradeoff among quality, point of diminishing returns, and the need to start a new plot.

UNUSUAL CONFIGURATIONS:

As discussed elsewhere in this manual, it is possible to use the Expressway in configurations other than the printer/plotter paradigm used for essentially all of our examples. Here are some of the things that you can (and can't) expect to do.

MULTIPLE PLOTTERS:

You CAN connect two plotters (at two different bus addresses) to both Expressway output ports. You must configure both port boards for plotter operation; the Expressway will interrogate both and return the appropriate information to the host as detailed in Appendix 1. This is the best way to do DIFFERENT PLOTS on the TWO PLOTTERS.

You CAN also connect two plotters to the same output port, on the same select code, to generate IDENTICAL PLOTS. In fact you can connect up to 15 plotters total to each output. As described in HP literature, ALL BUT ONE of the plotters must have its LISTEN ONLY switch turned on.

You CANNOT make identical plots by connecting two plotters to two different select codes on the two Expressway output ports and addressing both to listen simultaneously. See "MULTIPLE LISTENERS", below.

MULTIPLE PRINTERS:

Everything said above applies to printers, except of course that the port boards should be set for printer operation.

OTHER DEVICES (as data recipients):

It is not necessary to connect a plotter or printer to the Expressway. Any IEEE-488 device can be connected, providing that it does not call upon the Expressway to perform functions for which it was not designed. Limitations include:

1: The device must accept ASCII terminators (cannot require EOI). The Expressway does not store EOI bits, since this would require a diminution of memory for buffering.

2: The device must not REQUIRE special servicing upon generating SRQ (except for physical service, like replacing paper.) Because of the serial nature of the Expressway, passing SRQ back to the host would normally be meaningless.

3: It is OK for the device to hold off a handshake for an indefinite period, such as when it requires new paper, tape, or whatever.

OTHER DEVICES (as data generators):

A unit that acts as an HP-IB controller can be connected to the host port. Many instruments, such as the HP8568B spectrum analyzer, generate plots under their own initiative. These plots typically tie up the instrument for minutes. Connecting the Expressway just as is done for a desktop computer can

enhance the value of these instruments. For example, the 8568B takes about three minutes to produce an annotated plot. Adding the Expressway in series reduces the time the analyzer is tied up to about 3 SECONDS!

To take advantage of this capability, your instrument must act as a controller. Certain HP instruments (such as the 8561 FFT analyzer) use a different protocol: They must be set in the "talk only" mode. In the present incarnation of the Expressway software, there is no capability for accepting data from these instruments.

Refer to the appropriate instrument manual to determine if it is usable with the Expressway.

MULTIPLE LISTENERS:

The IEEE-488 protocol, and most HP computers allow you to address multiple devices. The normal HP method is to specify more than one address, e.g.,

OUTPUT 705,706,707; "hello there"

You cannot do this with the Expressway! The Expressway is only a single device, and we had to make the usual tradeoff, speed vs. versatility. If it were necessary to examine the address state for each data byte and then place the data in two queues simultaneously, it would be much slower. We rejected doing so for two reasons:

1: The multiple listener configuration is very uncommon; and,

2: If you MUST do it, the most efficient way is to set both devices to the same bus address and put one on LISTEN ONLY.

By the way, there is no prohibition on having two Expressways listen simultaneously. Assume you have two Expressways; the first is connected to a plotter on 705 and a printer on 701, the second to a plotter on 706 and a printer on 702. It is perfectly valid to send data to both plotters by

OUTPUT 705,706;"VN"

or to talk to both printers with

OUTPUT 701,702;"I want my Maypo."

PHYSICAL BUS EXTENSION

Recall from discussions of HP-IB use that there is a physical limitation as to how many devices can be connected to a single IEEE-488 bus. Although it is theoretically possible to address 30 devices from a single controller, you are limited to 15 devices and 20 metres of cabling by capacitance and other loading considerations.

The Expressway obviates this problem in two ways:

1: The Expressway INPUT presents ONE LOAD to the computer, yet can drive TWO select codes. Thus it's possible to expand the system to the maximum number of addresses available.

2: Each Expressway OUTPUT can drive 15 LOADS. If your system incorporates more than one device at the same bus address, you can drive them from one Expressway port, thus leaving the host port available for even greater

peripheralization.

3: Three ways, actually. The Expressway can also be used to extend the
    cable length, since it can be on the end of a 20 metre cable, and
    it can drive a 20 metre cable. In fact, by connecting Expressways
    in series (see considerations in Appendix 2), you can extend
    your bus indefinitely, as well as piling on the megabytes.

USE WITH OTHER DEVICES ON THE HOST BUS

Hewlett-Packard has recommendations with respect to connecting slow, medium-
speed, and fast devices on the same physical bus. We won't repeat them here,
but will discuss the characteristics of the Expressway. It can normally be
considered a medium speed device. It can accept data at a maximum average
rate of 20KBytes/second. However, it can hang up the bus under three
circumstances:

1: When it is powered up, it may refuse to handshake during certain portions
    of its power-up sequence. (It should not be turned on while the bus is
    active. It can be turned on while no transactions are occurring, but
    this is poor practice. It is better to power up the whole system at
    once.)

2: During internal operation, it can hold off data for up to about 2msec.
    (This does not affect the average transfer rate since it doesn't happen
    very often.)

3: When the Expressway is FULL, it can hold off data indefinitely. If you
    fill it up a lot, you should consider getting more memory. You can use
    TIMEOUT statements to prevent this from hanging up the system, or, more
    conveniently, ignore it since it will not stay full for more than a second
    or so unless there's a problem at the output end.

OTHER BUS OPERATIONS:

Here's how the Expressway reacts to various unusual bus commands outside the
ordinary course of business:

REMOTE/LOCAL/LOCAL LOCKOUT: IGNORED

SERIAL POLL: IGNORED

PARALLEL POLL: IGNORED

PARALLEL POLL CONFIGURE/UNCONFIGURE   IGNORED

IFC   INTERNAL RESET OF GPIB CHIP, can cause lost data

SECONDARY ADDRESSES   IGNORED

CLEAR   IGNORED

GROUP EXECUTE TRIGGER   IGNORED

SRQ   NEVER ASSERTED

SPECIAL NOTE ON SOME PLOTTERS

Certain HP plotters require more initialization than simple turn-on. For instance, the 7580 series of drafting plotters do not define P1 and P2 points until paper is actually inserted and measured. For these plotters, you should follow this initialization sequence:

1: Turn on plotter
2: Install paper and hit VIEW button.
3: Hit REMOTE button, activating the computer connection.
4: Finally, turn the power to the Expressway ON.

Other present and future HP plotters may require paper insertion. If you have a problem getting your software to recognize the plotter, this could be the cause.

If you are writing programs that will output to this plotter, you can make life easier for yourself or the ultimate user by not interrogating the plotter unless necessary. If the output will always be on a fixed size paper, for instance, build this information into the program rather than getting it from the plotter.

HOW ABOUT MULTIPLE PLOTS?

A question frequently asked about the Eventide Expressway is:

How do I stack multiple plots, given that I have to change the paper in the plotter?

There are two types of plotters...those that automatically change paper, and those that don't.

There are two types of those that don't...those that can be made to behave, and those that can't.

Paper advancing plotters, the 9872T, 7550A, and 7586, can stack plots simply by placing a PG command between plot files. This must be done by the computer if you're using the Expressway.

Non-advancing plotters that can be made to behave...the 7580 and 7585 drafting plotters, respond to the NR (Not Ready) command by holding off further plot commands until manually re-enabled. This provides an opportunity to replace the paper. This command must be inserted by the computer for use with the Expressway.

Non-advancing plotters that don't accept the NR command will simply keep plotting until the buffer is empty. This is a problem.

This section tells you in more detail how to set up the Expressway than the earlier brief description. Read this section for information on what the internal switches do, and how to set them for your peripheral configuration.

PHYSICAL AND ELECTRICAL DESCRIPTION

Depending upon options purchased, the Expressway can have from 3 to 7 internal printed circuit boards. They are:

1: The "motherboard". This assembly comprises the "brain" of the unit, a 6MHz clock rate Motorola 6809 pseudo-16bit microprocessor, and the logic and EPROM circuitry necessary for it to operate. Also on this board are all elements of the power supply except the mains transformer, and up to 1 megabyte of memory, depending upon how much was ordered with the unit.

Dip switches on this board control the configuration of the unit, including the size of memory to be accessed, and the mode of selftest when powered on.

2: The front panel board. This assembly is nothing more than a bunch of LEDs (Light Emitting Diodes) which advise the user of the status of operation.

3: At least one, and up to 4 port boards. These boards have the IEEE-488 interface circuitry that allows the Expressway to communicate over the HP-IB. Each board has a dedicated IEEE-488 talker/listener/controller chip, and "transceiver" chips which translate the logic signals from this chip to the rather more robust signals necessary to drive and receive EPROM for specific configurations, allowing customization if necessary. Because these are plug-in boards, it is possible to field-update the unit to new configurations, or to replace one that has become damaged due to unforseen electrical circumstances.

Dip switches on these boards control the port address ("select code") and type of operation, such as whether the board should perform in the plotter emulation mode.

Optional RS-232 port boards may be substituted for IEEE-488 port boards 1 or 2 (outputs). These boards are appear to the host as pseudo IEEE-488 addresses. Details of baud rate, parity, etc., are set on the boards themselves.

4: An optional 1 megabyte memory board, which increases the total memory capacity of the buffer to 2 megabytes.

To determine the configuration of your unit, you can count the number of ports and examining the connectors on the rear panel. You can determine the memory capacity by examining the serial number plate or looking inside the unit.

DISASSEMBLY

You might want to disassemble the unit for several reasons:

1: Change the settings of the default or selftest switches.

2: Install additional port boards or additional memory.

3: Idle curiosity.

4: Service.

To do so, remove the ten screws around the lip of the chassis on both sides. DO NOT remove any screws on the front or rear panel. When you have removed the cover screws, the cover will simply lift off straight up.

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CAUTION
When re-assembling, be
sure not to catch any
cables between the
cover and the chassis.

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SETTING THE CONFIGURATION SWITCHES

The motherboard has one 8-position dip switch; IEEE-488 port boards have two 8-position dip switches. The port switches are oriented in a front to rear direction and are numbered 1 through 8, with switch 1 being closest to the front panel of the Expressway. Different brands of switches may be installed and each manufacturer has its own way of specifying onness and offness. (The motherboard switch is physically reversed; refer to the numbers on it.) A switch is ON when it is pressed towards the CLOSED position. It is OFF when it is pressed towards the OPEN position.

Optional RS-232 port boards have four sets of 8 dip switches. The settings of these switches are completely described in Appendix 4.

Some switches have little sliders that move from OFF to ON, some have rockers that must be pressed down. Still others (those used on the port boards), look like little piano keyboards. To turn a rocker switch off, push straight down on the OFF side with a pointed object. To turn the other types OFF, move them to the position labelled "OFF", "OPEN". or "0".

MOTHER BOARD SWITCHES

SWITCH #   FUNCTION

8   NONE: Leave ON
7   NONE: Leave ON
6   NONE: Leave ON
5   NONE: Leave ON

    4 & 3   MEMORY CONFIGURATION
   ON   ON   256K   (all 64K RAMs installed on mother board)
  OFF   ON   1 MEG (all 256K RAMs installed on mother board)
   ON   OFF   2 MEG (all 256K RAMs insalled on mother board, and
                          additional memory board installed.)

    2 & 1   SELF TEST
   ON   ON   NORMAL OPERATION
  OFF   ON   CONTINUOUS SELF TEST
   ON   OFF   CONTINUOUS SELF TEST WITH LOOP THROUGH
                  (For more information on self test, see service info.)

When shipped from the factory, all switches are ON, except those necessary
to set the correct memory configuration.

PORT BOARD SWITCHES

The dip switch closest to the front panel has all switches ON in the case of
HP-IB port boards, and all switches except #1 ON on RS-232 boards. These
switch settings must not be changed.

All buffers currently being shipped have either two or three port boards
installed. (For a single port buffer, you might consider the Eventide GpiBuf.
Data sheets are available upon request. One and four port versions of the
Expressway are under development.) The ports are numbered on the rear panel
as PORT 0...PORT 3. Port 0 is always connected to the host computer/controller
and the switches on this port board should remain ON as shipped.

TWO PORT EXPRESSWAYS:

PORT 1 is factory configured as a plotter port, set to default HP-IB address 5.
The default switch settings are:

1	2	3	4	5	6	7	8
OFF	ON	OFF	ON	ON	ON	ON	OFF

THREE PORT EXPRESSWAYS:

PORT 1 is factory configured as a plotter port, set to default HP-IB address 5.
PORT 2 is factory configured as a printer port, set to default HP-IB address 1.
The default switch settings are:

			PORT 1									PORT2				
1	2	3	4	5	6	7	8		1	2	3	4	5	6	7	8
OFF	ON	OFF	ON	ON	ON	ON	OFF		OFF	ON	ON	ON	ON	ON	ON	ON

Switches 1 through 5 determine the HP-IB bus address the port will address,
and the address which will be reported back to the computer as being present.
(See theory of operation for a description of how this works.) The switch
settings must correspond to the address setting for the device which the
computer or Expressway is talking to. For example, if your printer is at
select code 701 the switches on the Expressway must be set to HP-IB address 1.
The switches are set in a binary fashion:

SWITCH					HP-IB ADDRESS	COMMENT
1	2	3	4	5		
ON	ON	ON	ON	ON	0	
OFF	ON	ON	ON	ON	1	DEFAULT FOR PRINTER & FOR 1st OPTIONAL RS-232 PORT
ON	OFF	ON	ON	ON	2	
OFF	OFF	ON	ON	ON	3	
ON	ON	OFF	ON	ON	4	
OFF	ON	OFF	ON	ON	5	DEFAULT FOR PLOTTER & FOR 2nd OPTIONAL RS-232 PORT
ON	OFF	OFF	ON	ON	6	
OFF	OFF	OFF	ON	ON	7	
ON	ON	ON	OFF	ON	8	
OFF	ON	ON	OFF	ON	9	
ON	OFF	ON	OFF	ON	10	
OFF	OFF	ON	OFF	ON	11	
ON	ON	OFF	OFF	ON	12	
OFF	ON	OFF	OFF	ON	13	

ON	OFF	OFF	OFF	ON	14	
OFF	OFF	OFF	OFF	ON	15	
ON	ON	ON	ON	OFF	16	
OFF	ON	ON	ON	OFF	17	
ON	OFF	ON	ON	OFF	18	
OFF	OFF	ON	ON	OFF	19	
ON	ON	OFF	ON	OFF	20	Used by HP as non-controller address. Avoid.
OFF	ON	OFF	ON	OFF	21	Used by HP (and the Expressway) as the controller address. DO NOT USE!
ON	OFF	OFF	ON	OFF	22	
OFF	OFF	OFF	ON	OFF	23	
ON	ON	ON	OFF	OFF	24	
OFF	ON	ON	OFF	OFF	25	
ON	OFF	ON	OFF	OFF	26	
OFF	OFF	ON	OFF	OFF	27	
ON	ON	OFF	OFF	OFF	28	
OFF	ON	OFF	OFF	OFF	29	
ON	OFF	OFF	OFF	OFF	30	
OFF	OFF	OFF	OFF	OFF	31	HP-IB universal command. DO NOT USE!

Switch 6 has no function and should remain ON.

Switch 7 determines whether the plotter is to be initialized with the HPGL "IN" command after the plotter interrogation sequence. (See Appendix 1.) This switch defaults to NO INITIALIZE COMMAND (switch ON.) This switch is relevant only if switch 8 (see below) is also OFF.

Switch 8 should be set OFF if the port is connected to an HP or other HPGL (Hewlett-Packard Graphics Language) plotter. Turning this switch OFF causes the Expressway to perform certain plotter emulation functions. This allows the host to believe that there is an HP plotter attached to it without an intermediary, and "fools" many software packages into using the Expressway in lieu of the plotter. See Appendix 1 for specific information on this mode; see Theory of Operation for an overview of how it performs.

Switch 8 should, of course, be set ON if no plotter is connected.

OPTIONAL RS-232 PORT BOARDS

If your unit has an optional RS-232 port substituted for an IEEE-488 port, the above discussion FULLY APPLIES. There are FOUR sets of dip switches installed on each RS-232 port board. The two farthest from the front panel of the Expressway are set identically to the settings of the IEEE-488 boards. I.e, the rearmost determines the address and the plotter emulation mode; the one in front of it should not be adjusted. As far as the host is concerned, there is no difference between the operation of the RS-232 board and that of the IEEE-488. Data is queued identically, and instead of the 3-wire IEEE-488 handshake, standard RS-232 protocols are used. For more information on the RS-232 protocols implemented by the board, and other important information on setup and switch settings, please see the RS-232 PORT BOARD Appendix 4.

Note that if you are using an RS-232 port, it will appear to the computer to have an HP-IB address. For example, if you connect a plotter to an IEEE-488 port at address 5, and a LaserJet printer to an RS-232 port at address 1, you will address both devices as IEEE-488 devices. Corresponding BASIC statements are:

    PLOTTER IS 705
    PRINTER IS 701

INSTALLING ADDITIONAL MEMORY

The additional one megabyte memory board may be installed only in Expressways that have a full megabyte on the motherboard. (If you have 64K RAMs on the motherboard, it will be impossible to upgrade the Expressway in the field. In this case you should contact Eventide to find out what upgrade program is available.)

To install the board, remove the top cover as described earlier. Plug the new board, component side up, on the connectors provided. The connectors are keyed to prevent reversed installation. BE SURE TO INSPECT YOUR INSTALLATION TO MAKE SURE THAT ALL PINS ARE PROPERLY SEATED!

Set the dip switches on the mother board for the new memory configuration. (Switch 5 ON, switch 6 OFF.) Then reassemble the unit and turn it on, observing the self test sequence. Note that self test will require almost twice as long to complete with the new memory installed.

INSTALLING ADDITIONAL PORTS

Refer to the following page for the installation procedure of additional ports. Carefully note which piece of hardware goes where.

After completing the physical installation, configure the dip switches as explained above, reassemble the unit, and turn it ON. Be sure to observe the self-test sequence to confirm that no problems have been induced.

INSTALLING ADDITIONAL PORTS

1: Turn off front panel power switch and REMOVE POWER CORD.

2: Observe static precautions: Work on a conductive surface, and always touch the surface and the Expressway chassis to ground any charge before touching any circuit boards or components.

3: Remove the 10 screws holding the top wraparound cover and lift it off.

4: Remove the blank filler plate from the desired opening (2 screws).

5: Remove LOWER jackscrew and lockwasher from new port board to be installed.

6: With the rear end of the Expressway facing you, lower the port board into the chassis assembly so that the gold edged fingers are resting on the circuit board just to the left of the corresponding receptacle. Angle the IEEE-488 connector through the rear panel opening so that the connector and the jackscrew are protruding through the opening.

7: Lift board straight up so that the fingers clear the edge of the socket. Move card to the right so that the card edge is directly over the socket. Push downward so that it seats firmly.

8: Screw in the jackscrew and lockwasher removed in step 5 just below the IEEE-488 connector. Do not tighten it yet.

9: Install the short 4-40 flathead screw into the top hole and tighten it. Now tighten the bottom jackscrew.

10: Replace top cover using as many of the ten screws as you can still find.

As explained in the Theory of Operation, it is inherently impossible for a
serial device such as the Expressway to hold a true two-way conversation with
a device, since there will be data in the host-to-device queue when a query
for the device is initiated. Thus, the device will not be in the appropriate
state when the query is received.

Many programs which use plotters do require information from the plotter.
Fortunately, this information is usually required at the beginning of the
plot for setup purposes. In order to avoid the necessity for two-way
communication, the Expressway automatically interrogates the plotter and
stores the returned information. This information is passed to the host
when requested, without further involvement of the plotter. Thus two-way
communication is obviated.

We have carefully planned this interrogation to provide sufficient information
to the host in all cases we anticipated. However, we are not infallible,
HP from time to time adds commands, and you may be doing something not
contemplated during the firmware design (or something that shouldn't be done,
such as attempting to digitize (DP command) in a one-way situation).
The table below shows what the Expressway does. If this doesn't work in
your situation, it may be necessary to change your or our software. Eventide
has a committment to make our Expressway as nearly universally compatible as
possible, and we are willing to consider firmware changes. However, it is
usually better to make the changes in your software if you can.

At power on, the Expressway sends the following commands to the plotter, and
attempts to obtain the plotter's answer. As different plotters respond to
different HPGL commands, there is frequently no response. (You will see
the plotter's ERROR light flash if it receives such a command.) If the
plotter does not respond, the Expressway notes this and continues. Should
the Expressway later receive a request that the plotter did not respond to,
it will emulate the plotter, i.e., the Expressway will not respond either.

If the Expressway receives an interrogation it does not recognize, it will
respond with a CR/LF sequence, but no data.

The sequence of inquiries is "OO, OI, OF, OT, OP, OW, OH, OE, IN."

The first seven request information only. OE (output error) turns off the
plotter ERROR light, and IN optionally initializes the plotter. IN is only
sent if SWITCH 7 is set to OFF, as described in the setup section.

The Expressway recognizes only the HPGL commands listed below, and responds
appropriately, normally as determined by the plotter.

PLOTTER EMULATION TABLE

HP-GL COMMAND SENT SENT TO EXPRESSWAY	DATA RETURNED TO HOST (+cr/lf)	COMMENTS
OA	0,0,1	current position meaningless...pen moving
OC	0,0,1	" "
OD	0,0,1	" "
OE	0	no error indicated
OF	read response	
OH	same data as read from OW command	
OI	read response	
OO	read response	output options
OP	read response	
OS	17	pen down, ready for data
OT	read response	
OW	read response	
esc.A	0	
esc.B	0	
esc.E	0	no error indicated
esc.L	0	
esc.O	8	
esc.S	0	
unrecognized	cr/lf only	

Note: Some HP-GL plotters do not respond to some commands shown. In such cases, the Expressway will not respond, even with CR/LF. (Some plotters, such as the 9872A, will light an error LED when confronted with these commands.)

APPENDIX 2
USING MULTIPLE EXPRESSWAYS

It is possible, although perhaps not economical, to connect Expressways in series for additional buffering. This might prove desirable if your combined print and plot data exceeds approximately two megabytes. For instance, if you have a 3 megabyte plot, and a 1 megabyte print run, you might want to connect an extra Expressway in the plotter circuit.

The mechanics are pretty simple. For each Expressway, you will also need an additional HP-IB cable of suitable length. The steps are as follows:

1: Connect the first Expressway as described in the Setup section.
2: Connect the second as follows:
    A: Input (PORT 0) to the plotter output (PORT 1) of the first.
    B: Plotter to PORT 1 of the second.

If you want extra buffering for the printer, step two would be:
    A: Input (PORT 0) to the printer output (PORT 2) of the first.
    B: Printer to PORT 2 of the second.

It is possible to connect Expressways in series indefinitely according to the above outline. This is the equivalent of a 1-ohm short across your treasury, and will make us very happy indeed.

And, finally, if you want extra buffering for both printer and plotter, connect an Expressway in series with each output of the first as described above.

TURN-ON SEQUENCE

In order to provide plotter emulation, each part of the system must look correct when interrogated. Thus, when powering up the system, turn on the plotter and the Expressway closest to that plotter first. After that Expressway has completed self-test, turn on the second (closest to the host.)

Expressways connected to printers or other receive only devices may be turned on in any order.

The Expressway incorporates a thorough selftest capability. This is included for several reasons, chief among them being the ability of the user to confirm that the unit is working properly without reference to external devices, and the ability to diagnose and repair simple faults if it isn't. When the Expressway is turned on, it tests itself briefly to determine that most of its circuitry is working. An optional "loop through" is also provided that tests circuitry that cannot be tested during the brief turn-on test. If an RS-232 PORT is installed, loop test ignores it.

This appendix describes the selftest, front panel indications during self-test, and some of the steps that you can take if selftest fails.

As described under SETUP, there are three options for selftest; turn on, continuous, and loop through. (Loop through is continuous as well.) In order to select a continuous test, you must open the unit and turn the switch as described in that section. In order to select the loop through test, you must also connect HP-IB cables between all the ports. When you do so, make sure that the cables are not connected to anything else. I.e, a cable should go from PORT 0 to PORT 1, and another cable should be piggybacked from PORT 1 to PORT 2. Once you have selected the test you desire, turn on the unit and look at the lights. Here's what they mean:

LED TEST: To avoid misinterpreting indications because of bad indicators, the first test is for the LEDs themselves. You will observe a sequence that looks like this:

```
*ooooo   **oooo   ***ooo   ****oo   *****o   ******   ******
  oo       oo       oo       oo       oo       oo       *o

******   o*****   oo****   ooo***   oooo**   ooooo*   oooooo
  **       **       **       **       **       **       **
```

ending with all LEDs extinguished except selftest: oooooo
                                                       *o

If any LED fails to come on in the proper sequence, although the test seems to be running properly, you probably have a bad LED or bad front panel board. More importantly, the results of subsequent tests will be suspect.

Following the LED test, additional tests are performed, denoted by the LED indications shown.

CPU RAM TEST (lower 16K bytes of Random Access Memory)

```
*ooooo
  *o
```

ROM CHECKSUM TEST

```
o*oooo
  *o
```

PORT 0 INTERNAL TEST   PORT 1 INTERNAL TEST   PORT 2 INTERNAL TEST

```
**oooo                    oo*ooo                    *o*ooo
  *o                        *o                        *o
```

TRANSFER BETWEEN PORT 0 and PORT 1*   TRANSFER BETWEEN PORT 0 and PORT 2*

o**ooo   ***ooo
  *o   *o

*Only if loop through test selected

                          SECTOR RAM TESTS:
ACCESS   ADDRESS LINES   REFRESH CIRCUITRY   BYTE TEST

ooo*oo   *oo*oo   o*o*oo   **o*oo
  *o   *o   *o   *o

If you have selected normal selftest without loopthrough, and at least one
port has its plotter emulation switch on, the following display appears while
the port is interrogating and initializing the plotter:

*o*o*o
  oo

If the ERROR light is OFF when the selftest light goes out, the unit passes.
If the light is ON, then the remaining lights must be interpreted to
determine the problem. (If you return the unit to Eventide, be sure to
indicate the selftest error along with other observations on your trouble
report.)

RAM ACCESS ERROR (confirm RAM option switches set right; return to factory.)

*ooooo o*oooo **oooo oo*ooo *o*ooo o**ooo ***ooo ooo*oo *oo*oo o*o*oo
  o*   o*   o*   o*   o*   o*   o*   o*   o*   o*

ROM CHECKSUM ERROR (EPROM should be replaced)

**o*ooo
  o*

PORT ERRORS: While these errors are usually listed under specific·ports, it
is possible that the error shown is caused by the receiving port instead of the
sending port as shown. Therefore, you might want to swap boards or chips
anyway to confirm that the specific port is bad.

PORT 0

o**o**
  o*

PORT 0 or PORT 1

***o*o   ooo**o
  o*   o*

PORT 0 or PORT 2

***oo*   ooo*o*
  o*   o*

```
PORT 1
----------------IEEE488------------------------      ------------RS-232------------
*ooo*o   o*oo*o   **oo*o   oo*o*o   *o*o*o   o**o*o   o*o**o   **o**o   oo***o   *o***o
   o*       o*       o*       o*       o*        o*       o*       o*       o*       o*

PORT 2
----------------IEEE488------------------------      ------------RS-232------------
*oooo*   o*ooo*   **ooo*   oo*oo*   *o*oo*   o**oo*   o*o*o*   **o*o*   oo**o*   *o**o*
   o*       o*       o*       o*       o*        o*       o*
```

INDIVIDUAL RAMS Remove cover so that circuit board is visible. Orient unit
so that legends on board are readable (front panel to your left.)

```
RAM #        51       47       43       39       35       31       27       23
ERROR CODE ***ooo   o**ooo   *o*ooo   oo*ooo   **oooo   o*oooo   *ooooo   oooooo
            **       **       **       **       **       **       **       **

RAM #        50       46       42       38       34       30       26       22
ERROR CODE ****oo   o***oo   *o**oo   oo**oo   **o*oo   o*o*oo   *oo*oo   ooo*oo
            **       **       **       **       **       **       **       **

RAM #        49       45       41       37       33       29       25       21
ERROR CODE ***o*o   o**o*o   *o*o*o   oo*o*o   **oo*o   o*oo*o   *ooo*o   oooo*o
            **       **       **       **       **       **       **       **

RAM #        48       44       40       36       32       28       24       20
ERROR CODE *****o   o****o   *o***o   oo***o   **o**o   o*o**o   *oo**o   ooo**o
            **       **       **       **       **       **       **       **
```

As described in this appendix, the Expressway has a rather thorough and complete self test capability. Unfortunately, self test can only point out that a problem exists and usually diagnose the problem. It cannot by itself repair anything. (We do not predict immediate availability of an update ROM with Waldoes and a soldering iron.) If you are having a problem with your Expressway, there are generally three things you can do.

1: Fix it yourself.

2: Try to fix it yourself.

3: Send it to Eventide for repair.

If your unit is under warranty, you will probably want to use alternative 3. This alternative also looks pretty good if you're clumsy, have never used a screwdriver and don't care to learn to, or in general don't want to be bothered with science stuff. HOWEVER,

We've gone out of our way to make the most common problems the easiest to repair, and are generally pretty nice about "voiding the warranty" stuff. In other words, we won't arbitrarily charge you a fortune if you try to fix it and fail. (We won't charge arbitrarily...that doesn't mean that you can connect the AC line to the +5 supply and then expect us to furnish a new board to replace the charred one returned.)

Basically, only a limited number of things can go wrong with the Expressway, and each of them has a good reason. They are listed in order of (approximately) decreasing probability.

1: Cockpit error: The switches are set wrong. A cable is loose or missing. Something isn't plugged in. The system was turned on in the wrong order. Etc.

2: Mechanical stuff: Loose connectors (internal or external). Loose boards. Bad dip switches. Bad connectors.

3: Defective memory   There are up to 64 identical memory chips in each
    chip: Expressway, outnumbering all the other chips combined. These are also the most complicated chips. If something is going to fail, it is likely to be a RAM.

4: Defective bus   Because these chips are directly connected to the
    driver chip: outside world, they are far more susceptible to voltage transients than are the others.

5: Power supply   These components get warmer than the rest of the unit,
    problem: and consequently have potentially poorer reliability.

6: Something else: See? We told you there were only a limited number of possibilities!

Before returning a unit to Eventide for repair, it is your responsibility to eliminate Cockpit error and external Mechanical stuff as causes. If you don't do so, and this is the problem, we obviously won't be able to fix it. If you want to work on it yourself, proceed to the remaining items:

The balance of #2, Mechanical stuff, is most likely to manifest itself as an intermittent problem. Take the unit apart, jiggle everything, and exercise all the switches.

#3, A defective memory chip, will usually be diagnosed by self test. (A grossly defective chip can give other indications, such as bad addressing, instead.) If a bad chip is indicated, DO NOT CHANGE IT until you have verified the result. Run self test at least twice, and confirm the same chip shows up each time. The reason for this is that other problems, such as #5 or #6, can make several chips appear defective. It is very unlikely that multiple chips will fail simultaneously. If this seems to have happened, suspect a common cause. If you do decide to replace a RAM chip, be sure you do it carefully to avoid damaging the board.

#4, a bad bus driver chip, will normally show up as errors in data being transferred to or from the Expressway, typically a consistent single bit error. While the turn-on self test will normally not diagnose a bad driver chip, the loop-through test available by setting the dip switches usually will. Because these chips are in hazard-prone locations, electrically speaking, we have installed them in sockets. They can be interchanged among the port boards to confirm that a particular one is bad, and replacements can be had by mail (if you've returned your warranty form.) Observe the standard precautions:

1: Never remove or install a chip when power is applied.
2: Make sure all the pins are straight and installed in the sockets properly.
3: Watch out for static damage...try to keep one hand on the metal chassis while touching circuitry so that you and the rest of the unit are at the same potential.

#5, a Power Supply problem, is likely to be indicated by a complete failure of the unit, such as no lights, erratic or no operation, or inconsistent self test results. Connect an oscilloscope and/or voltmeter to the three points shown on the schematic (+5,+9,-9.5). Confirm that the unregulated voltages are correct and that the 5 volts is clean and accurate within 5%. If they're not, the power supply is probably defective.

#6, Something else, is the catchall for bad logic chips, obscure software bugs we never caught, and other randomly defective components. Unless you want to make a project of this, we suggest that problems not diagnosed and repaired using the above hints be abandoned, and the unit returned to us.

The Service portion of this appendix is not intended to be a complete guide to electronic troubleshooting. If you feel uncomfortable about anything said above, it's probably because you've never worked on electronic equipment before. This is no sin. Our customers vary from people who could design the chips used in the Expressway to those who want to know where to find the fish to go with them. If you're among the latter, don't worry about a thing, just send us the unit.

APPENDIX 4
USING THE OPTIONAL RS-232 PORT

The RS-232 port board may be substituted for one or both of the HP-IB port boards connected to peripherals. (It may not be used as the board connected to the computer/controller.) When an RS-232 board is installed, it allows the computer to communicate with an RS-232 peripheral in the same fashion as it would otherwise communicate with an HP-IB port. In fact, the host computer cannot even distinguish the existence of the RS-232 connection. It will perform as if the peripheral is actually an HP-IB device.

RS-232 is a bit serial format. Unlike the single data and handshake format used by HP-IB, RS-232 REQUIRES USER INTERVENTION, and frequently much head scratching before it can be coaxed to work correctly. Before achieving a successful interface, you will have to ascertain and probably modify the following parameters:

1: BAUD RATE, the SPEED at which the RS-232 port board and your peripheral communicate.
2: # OF DATA BITS, the size of your data word.
3: # OF STOP BITS, the time allowed between successive characters.
4: PARITY, the error detecting code (if any) to be used.

All of this information should be available to you in the manual for the peripheral you intend to connect. If it is not, you will have to contact its manufacturer.

Once you have set all these parameters correctly, you are still not out of the woods. Again unlike HP-IB, there is much confusion about RS-232 cabling. You must purchase or make a cable that will allow the port and peripheral to agree on which direction data and handshake lines are sending. We characterize our board in terms of inputs and outputs rather than using frequently confusing RS-232 terminology. You must determine which pins on your device are data receivers and which are transmitters, and connect them accordingly.

Finally, handshaking is implemented in a different fashion in RS-232. The RS-232 port board optionally implements two forms of handshaking, known as "hardware handshaking", and "XON/XOFF". You must determine if handshaking is necessary for your peripheral, and, if so, how to implement it. More on this subject later.

SWITCH SETTINGS

Here's how to set the various switches on the RS-232 board for the proper parameters. There are four dip switch packages on each board, and each package has 8 switches, labelled 1 through 8 from front to rear on the switch itself. The switch package closest to the front we will call A, and the package closest to the rear is D. Thus each individual switch can be designated A1 through D8 from front to rear.

First, determine the RS-232 parameters you need, then set the switches according to the table below. A switch is OFF if it is in the OPEN position, i.e., pushed away from the printed circuit board side of the switch assembly.

BAUD RATE: SWITCHES A1 through A5

A5	A4	A3	A2	A1	BAUD RATE
ON	ON	ON	ON	ON	50
ON	ON	ON	ON	OFF	75

```
ON    ON    ON    OFF   ON          110
ON    ON    ON    OFF   OFF         134.5
ON    ON    OFF   ON    ON          150
ON    ON    OFF   ON    OFF         200
ON    ON    OFF   OFF   ON          300          (FACTORY DEFAULT SETTING)
ON    ON    OFF   OFF   OFF         600
ON    OFF   ON    ON    ON          1050
ON    OFF   ON    ON    OFF         1200
ON    OFF   ON    OFF   ON          1800
ON    OFF   ON    OFF   OFF         2000
ON    OFF   OFF   ON    ON          2400
ON    OFF   OFF   ON    OFF         4800
ON    OFF   OFF   OFF   ON          7200
ON    OFF   OFF   OFF   OFF         9600
OFF   ON    ON    ON    ON          19200
OFF   ON    ON    ON    OFF         38400
```

PARITY: SWITCHES A6 through A8

```
A8    A7    A6    PARITY TYPE
ON    ON    ON    NONE            (FACTORY DEFAULT)
ON    ON    OFF   ODD
ON    OFF   ON    NONE
ON    OFF   OFF   EVEN
OFF   ON    ON    NONE
OFF   ON    OFF   ALWAYS 0
OFF   OFF   ON    NONE
OFF   OFF   OFF   ALWAYS 1
```

OF DATA BITS: SWITCHES B1 and B2

```
B2    B1    # OF DATA BITS
ON    ON       5
ON    OFF      6
OFF   ON       7      (FACTORY DEFAULT)
OFF   OFF      8
```

OF STOP BITS: SWITCHES B3 and B4

```
B4    B3    # OF STOP BITS
ON    ON       1
ON    OFF      1.5
OFF   ON       2      (FACTORY DEFAULT)
OFF   OFF     NOT USED
```

HANDSHAKE TYPE: SWITCHES B5 and B6

```
B6    B5    HANDSHAKE TYPE
ON    ON    NO HANDSHAKE (data runs continuously as available) (FACTORY DEFAULT)
ON    OFF   HARDWARE HANDSHAKE  (LOW on pin 5 stops port board from sending)
OFF   ON    XON/XOFF  (character value 19 stops sending, character 17 resumes)
OFF   OFF   HARDWARE AND XON/XOFF
```

RS-232 ID SWITCH: C1

Switch C1 identifies the board as an RS-232 board to the Expressway firmware.
It must be left in its OFF (OPEN) factory default position to avoid
unpredictable results.

PORT BOARD ADDRESS: SWITCHES D1 through D5

These switches determine the HP-IB address to which the RS-232 port board responds. Their settings are identical to those described in the SETUP section of this manual. Factory default for a single board is 1, for two boards are 1 and 5.

PLOTTER EMULATION RESPONSE: SWITCHES D7 and D8

These switches are identical in function to those on the HP-IB board. See information in Appendix 1.

RESERVED SWITCHES: B7, B8, C2 through C8, D6

The above switches are set ON at the factory and should remain ON.

ELECTRICAL CONNECTIONS

The RS-232 connector on the rear panel has 25 pins, of which only 7 are used for signal connections, and one as a ground. The active pins are as follows:

1:   GROUND

THE CONNECTOR LOOKS LIKE
THIS   (REAR VIEW)

2:   DATA FROM EXPRESSWAY TO PERIPHERAL (OUTPUT TO
     PERIPHERAL DEVICE)

3:   DATA FROM PERIPHERAL TO EXPRESSWAY (INPUT FOR
   PLOTTER DATA AND XON/XOFF CHARACTERS)

4:   READY TO SEND (RTS) OUTPUT FROM EXPRESSWAY. GOES
     HIGH WHEN HARDWARE HANDSHAKING IS ENABLED AND
     THE EXPRESSWAY IS PREPARED TO RECEIVE DATA FROM
     A PERIPHERAL (IN PLOTTER EMULATION MODE.)

5:   CLEAR TO SEND (CTS) INPUT FROM PERIPHERAL TO
     EXPRESSWAY. WHEN HARDWARE HANDSHAKING IS ENABLED,
     THE EXPRESSWAY WON'T SEND WHEN THIS LINE IS LOW.

6:   "DATA SET READY": PULLED HIGH BY 10K OHM RESISTOR.
     NO ACTIVE CONNECTION TO EXPRESSWAY LOGIC.

8:   "DATA CARRIER DETECT": PULLED HIGH BY 10K OHM
     RESISTOR. NO ACTIVE CONNECTION TO EXPY. LOGIC.

20: "DATA TERMINAL READY": PULLED HIGH BY 10K OHM
     RESISTOR. NO ACTIVE CONNECTION TO EXPY. LOGIC.
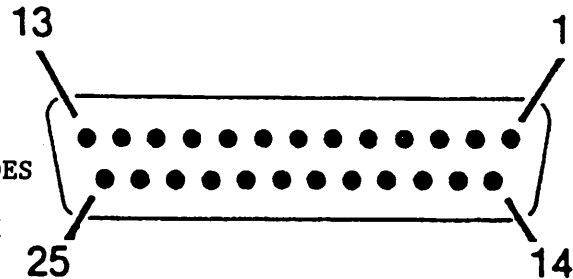
MORE ABOUT HANDSHAKING

Unlike HP-IB, there is no automatic handshaking in RS-232. If data is sent from the computer via the Expressway to the RS-232 port, the port will dribble it out continuously, at whatever speed is determined by the BAUD rate and other RS-232 parameters.

Depending upon the data speed, the peripheral MAY be happy with this arrangement. The factory default setting of 300 baud (a common data communications rate) is typically slow enough so that printers and other devices can accept data continuously with no need to handshake. As you

increase the baud rate, you might find that your peripheral can USUALLY
accept the data, but sometimes it gets full or cannot act on a character
fast enough. For example, older printers without small buffers of their own
can accept data rapidly while printing, but not while executing a carriage
return.

If a peripheral cannot accept data, it must tell the Expressway to stop sending
before a character gets lost. The Expressway responds to two forms of request.
If your peripheral pulls the CTS (Clear to Send) line low, it tells the
Expressway, in effect, NOT CLEAR TO SEND, and the Expressway stops outputting
data (assuming, of course, that HARDWARE handshaking is enabled.) When
the peripheral is ready again, it can release this line, and the Expressway
resumes.

For hardware handshaking to work, the wires must be connected correctly. It
is the peripheral's responsibility to pull down a line when it's not ready
for data. It is your responsibility to find out which line this is and to
connect it to pin 5 of the rear panel connector.

In some situations, there is no way to add extra wires (such as in telephone
connections.) If a peripheral uses the XON/XOFF protocol, it will send
the XOFF character (with a decimal value of 19, and an ASCII name of "DC3")
on the reverse channel. When the peripheral is again ready, it will send
the XON character (decimal 17, ASCII DC1).

For XON/XOFF handshaking to work, the peripheral's RS-232 output (TXD) pin
must be connected to pin 3 (RXD) on the rear panel of the RS-232 port board,
enabling two-way communication.

Because of the possibilities for confusion in implementing handshaking, we
recommend that you initially set the data rate low enough to not need it and
confirm that the system is operating correctly. Only then should you try
to get the handshaking to work at a higher baud rate. Remember that RS-232
terminology is sometimes confusing, and the critical thing is to determine
which pin of which device is GENERATING the required signal, and to wire it
to the corresponding pin which RECEIVES that signal.

The Expressway is controlled by an EPROM (Eraseable, Programmable, Read Only Memory.) This memory is an integrated circuit on the main circuit board of the Expressway. It is installed in a socket for easy replacement should this become necessary or desirable.

```
*************************************
               CAUTION!
     TO AVOID DAMAGING THE EXPRESSWAY
     BY STATIC DISCHARGE, ALWAYS TOUCH
     THE METAL CHASSIS BEFORE HANDLING
     THE INTERNAL PARTS.  TRY TO WORK
     ON A METAL OR ANTISTATIC SURFACE.
*************************************
```

To change the ROM, follow this procedure:

1: REMOVE THE POWER CONNECTOR!

2: UNSCREW THE TOP COVER AND LIFT IT OFF.

3: ORIENT THE UNIT SO THAT THE FRONT PANEL IS TO YOUR LEFT.

4: LOCATE THE ROM, WHICH IS A 28PIN IC WITH A PRINTED LABEL LOCATED ABOUT ONE INCH TO THE LEFT OF THE PORT ZERO BOARD SOCKET.

5: GENTLY PRY UP THE ROM FROM BOTH SIDES. ROCK IT BACK IN FORTH UNTIL IT POPS LOOSE. REMOVE IT AND PLACE IT ON AN ANTI-STATIC SURFACE.

6: INSERT THE NEW ROM IN THE SOCKET. THE NOTCH BETWEEN PIN 1 and 28 MUST BE ORIENTED TOWARD THE REAR PANEL OF THE EXPRESSWAY.

    (If you have difficulty inserting the ROM because of the limited clearance available, you might find it convenient to pre-compress the IC legs so that they will fit more naturally in the socket.)

7: CONFIRM THAT ALL PINS ARE FULLY INSERTED AND THAT THE NOTCH IS TOWARD THE REAR. INSERTING THE ROM BACKWARDS WILL DESTROY IT WHEN POWER IS APPLIED.

8a: IF THIS WAS A FREE UPDATE, INSERT THE OLD ROM IN THE NEW ROM'S PACKING MATERIAL AND RETURN IT TO EVENTIDE.
8b: IF YOU PURCHASED THE NEW ROM, KEEP THE OLD ONE AS A SOUVENIR.

9: REPLACE THE COVER AND USE THE EXPRESSWAY.

REVISION HISTORY

The ROM revision is determined by looking at its label.

REV A.0. Initial release, June 1985

REV A.1. August 1985. Fixes reported bug causing lost data when Expressway is full. Also permits operation with optional RS-232 port board.

REV A.1.1 August 1985. Adds OH command to plotter emulation sequence.

APPENDIX 6

WARRANTY

The Eventide Expressway is warranted for a period of two years against defects in material and workmanship.

During this period we will repair it free of charge, and return it to you at our expense (in the U.S.A.), PROVIDING:

1: It is returned to us fully prepaid.
2: The problem was not caused by physical or electrical abuse.

When returning the unit, make sure it is safely packaged, and ship it by a traceable method, such as UPS.

We will return it by UPS or another expeditious method of our choice unless you request a specific method. We reserve the right to charge for shipping if you do so.

NOTE TO FOREIGN CUSTOMERS

We regret that we cannot be responsible for shipping or customs clearance charges of any kind. If you need to return a unit to us, please make certain that all charges, INCLUDING CUSTOMS CLEARANCE, are prepaid to our door. Your freight forwarder will usually be able to arrange this. We can assist with customs clearance BY PRIOR ARRANGEMENT ONLY. Please contact us if you need further information.

PLEASE FILL OUT THE WARRANTY FORM

Here's why:

We can alert you to changes, improvements, and upgrades.

We can make sure you personally receive new product literature.

We can take into account when you received the Expressway, as opposed to our shipping date.

DOCUMENTATION

If you return the Expressway for service, please return a copy of your purchase invoice to establish warranty status.

and

MOST IMPORTANTLY: Enclose a TROUBLE REPORT explaining in detail why you are returning the unit! Without a trouble report, we have no idea of the problem you are experiencing, and cannot be sure of fixing it. If you do not send a trouble report, it will materially impede our normally rapid and efficient service.

WARRANTY FORM
EVENTIDE EXPRESSWAY

SERIAL NUMBER _____   MEMORY SIZE _____256K _____1MEG _____2MEG

ROM REVISION_____   #IEEE-488 PORTS_____ # RS-232 PORTS_____

DATE RECEIVED_____   OPTIONS_____

YOUR NAME_____

YOUR COMPANY_____

YOUR SHIPPING ADDRESS_____

YOUR CITY/STATE/ZIP_____

IF PURCHASED FROM DEALER, DEALER's NAME_____

DEALER ADDRESS_____

COMPUTER WITH WHICH THIS PRODUCT IS BEING USED_____

Do you have any suggestions that would make this product more useful for you?

_____

_____

_____

_____

Do you have any suggestions or requests for products that would be helpful
to you or to other HP desktop computer users?

_____

_____

_____

_____

Please return this form to   EVENTIDE INC.
                               1 Alsan Way
                               Little Ferry, NJ 07643
                               United States of America