Money Controls

Specification and Adjustment Manual

88X2500

S2000 Serial Eagle Bill Acceptor

ARDAC Brand S2000 Serial Eagle

ARDAC-1 Serial Protocol and Diagnostics

Money Controls Manual Part Number 44x496

Revision 1

BANKNOTE ACCEPTORS IN OVER 60 COUNTRIES AROUND THE WORLD

Specification and Adjustment Manual

88X2500

S2000 Eagle Serial

ARDAC-1 Serial and Diagnostics Protocols

    Manual Part Number 44x496
    Revision 1
    August, 2001

CONVENTIONS USED IN THIS MANUAL

In this manual, certain information will be set off from the main text for special consideration:

NOTE

A **NOTE** identifies additional information or instructions, which may help, clarify an operation or procedure.

CAUTION

A **CAUTION** identifies additional information or instructions, which should be followed to avoid damage to the equipment.

WARNING

A **WARNING** identifies safety-related information or instructions, which should be followed to avoid personal injury.

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1
<u>Introduction</u>

1.1 General Information

ARDAC Brand S2000 serial note acceptors are designed for the validation and collection of paper currency in a variety of vending machine and currency changer applications.

The serial note acceptor's microprocessor-control and other unique features allow it to be easily adapted to different user requirements as well as recognition of multiple note values.

Features of this ARDAC Brand Serial Note Acceptor include:

- Serial interface and comprehensive command set for versatile host-acceptor communication.

- Ability to hold a valid note in an escrow state, then collect or return the note on command from the host system or customer (through use of a suitable input device).

- Ready for immediate connection to ARDAC "B"-type and "C"-type note stackers.

- Built-in test mode. In test mode, the acceptor's sensing systems are activated to facilitate adjustments.

- Separate connectors for power, stacker, and host system.

- Easy setup and diagnostics using an IBM-compatible personal computer equipped with ARDAC Brand Host Simulator software.

- Wide operating temperature: 0°C to 50°C (32°F to 122°F).

- Environmental protection: All parts are either made from or coated with corrosion resistant materials. The entrance slot is angled to prevent entry of water.

- Simple power requirements: +5 Volts DC ± 5% @ 1 amp and +24 Volts DC ± 5% @ 500 mA.

1.2   Scope of this Document

This manual describes the signal connections, power requirements, and communication protocol of ARDAC Brand Model 88x2500 serial note acceptor. This acceptor employs a serial interface for communication with the host system.

This manual will help you integrate the acceptor into your particular application and write the host software routines needed to communicate with the acceptor. This manual also describes the ARDAC Host Simulator Software. The Host Simulator software simplifies communication between the PC and serial acceptor by:

A.   Minimizing the number of keystrokes the user must input to control the acceptor, and

B.   Providing a comprehensive display of data and system status. The Host Simulator presents information in a easy-to-understand, window-type format.

Together, the PC and Host software can be used as an economical, readily available host simulator for acceptor setup and diagnostics, or as a monitor of typical message exchanges between the host and acceptor. Information gathered in this way can assist you in writing software for the host system.
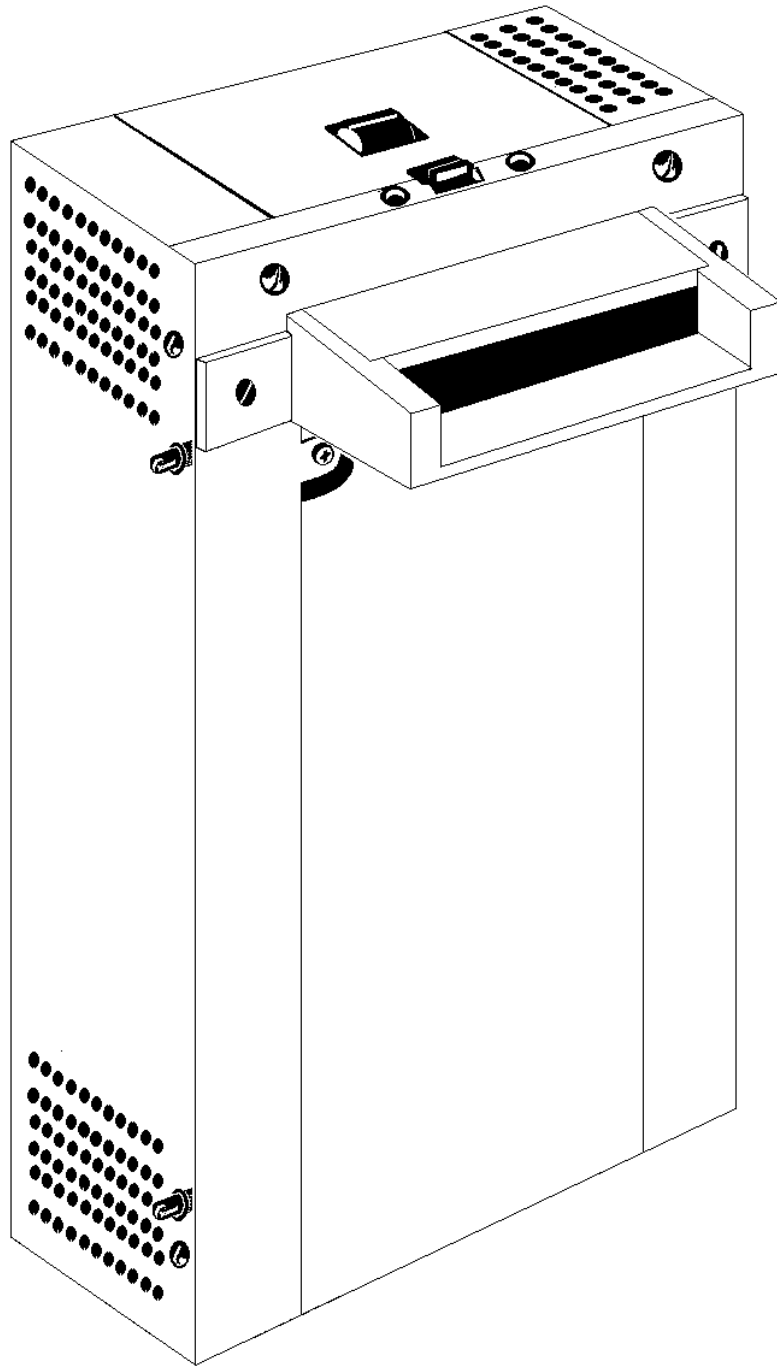
Figure 1-1
S-2000 Eagle Serial Interface, Vertical Note Acceptor

2
<u>Specifications</u>

2.1   **Model:**   88x2500 for Italian currency. S2000 Eagle serial interface acceptor
                         with vertical note path.

2.2   Currency Recognition

Note 1:   Italian 10,000 Lire inserted face up, head first.
Note 2:   Italian 10,000 Lire inserted face up, head last.
Note 3:   Italian 10,000 Lire inserted face down, head first.
Note 4:   Italian 10,000 Lire inserted face down, head last.

Note 5:   Italian 50,000 Lire (27 Maggio 1992 issue) inserted face up, head first.
Note 6:   Italian 50,000 Lire (27 Maggio 1992 issue) inserted face up, head last.
Note 7:   Italian 50,000 Lire (27 Maggio 1992 issue) inserted face down, head first.
Note 8:   Italian 50,000 Lire (27 Maggio 1992 issue) inserted face down, head last.

Note 9:   5 Euro inserted face up, top on left
Note 10:   5 Euro inserted face up, top on right
Note 11:   5 Euro inserted face down, top on left
Note 12:   5 Euro inserted face down, top on right

Note 13:   10 Euro inserted face up, top on left
Note 14:   10 Euro inserted face up, top on right
Note 15:   10 Euro inserted face down, top on left
Note 16:   10 Euro inserted face down, top on right

Note 17:   20 Euro inserted face up, top on left
Note 18:   20 Euro inserted face up, top on right
Note 19:   20 Euro inserted face down, top on left
Note 20:   20 Euro inserted face down, top on right

Note 21:   50 Euro inserted face up, top on left
Note 22:   50 Euro inserted face up, top on right
Note 23:   50 Euro inserted face down, top on left
Note 24:   50 Euro inserted face down, top on right

2.3   VEND and CREDIT Assignments

VEND/CREDIT 1: 10,000 Lire   (notes 1, 2, 3, 4)
VEND/CREDIT 2: 50,000 Lire   (notes 5, 6, 7, 8)
VEND/CREDIT 3: 5 Euro   (notes 9,10,11,12)
VEND/CREDIT 4: 10 Euro   (notes 13,14,15,16)
VEND/CREDIT 5: 20 Euro   (notes 17,18,19,20)
VEND/CREDIT 6: 50 Euro   (notes 21,22,23,24)

2.4   Firmware Version

57x2010.05-020.XX.XX

2.5   Interface and Connections

RS-232 serial interface, configured as Data Communications Equipment (DCE).

Communications parameters:

> Baud rate: 1200 baud.
> 11 bits, consisting of:
> 1 start bit,
> 1 eight-bit character,
> 1 odd parity bit, and
> 1 stop bit

Acceptor I/O: DB-9 pin, male, D-shell. Mating connector - DB-9.
Stacker I/O: 9-pin, Money Controls stacker interface cable 2x2782.

> Money Controls 35x130 (Molex 22-01-2091 housing)
> Money Controls 35x106 (Molex 08-50-0114 pins)

Power: 4 pin. Mating connector housing: AMP 280591-0. Pins: AMP 181299-2

2.6   Environmental Specifications

Temperature: 0°C to 50°C (32°F - 122°F).

Corrosion: All parts are either made from or coated with corrosion resistant materials.

Water: The entrance slot (note escutcheon) is angled to prevent entry of water.

2.7   Power Requirements

Voltage and current:

+5Vdc ± 5% @ 1A.

+24Vdc ± 5% @ 500mA (internal regulator provides +15Vdc from +24Vdc supply.)

2.8   Dimensions

Nominal dimensions, including escutcheon and excluding cables:

Height: 10.47" (265.9mm)

Width: 6.1" (154.9mm)

Depth: 4.86" (123.5mm)

2.9   Escrow Timeout

10 second timeout before note is returned (if timeout is enabled).

2.10   Note Stacker Information

Various model electromechanical single or dual note stackers (Type B or C) are available from Money Controls specifically designed for ARDAC Brand note acceptors. These stackers can stack the collected notes into one compartment, or selectively into two separate compartments, depending on the stacker model. Stacker capacity is approximately 750 notes for single compartment stacker or 140-160 notes in the small capacity side and 590-610 in the large capacity side of a dual compartment stacker.

3

<u>Application Information</u>

3.1   Introduction

Proper installation and maintenance are essential to any type of equipment. The serial acceptor's requirements are basic but important for correct operation. The following paragraphs describe these requirements.

3.2   Interface Considerations

Communication between the host and serial acceptor occurs over an RS-232 serial interface (see Figure 3-1). The physical and electrical characteristics of the acceptor-to-host link must adhere to all requirements of the RS-232 standard.

The serial acceptor operates as Data Communications Equipment (DCE) using the standard TX, RX, and GND pin out assignments of a PC-compatible, 9-pin serial port. As DCE, the acceptor can be connected to a 9-pin PC serial port using a straight-through cable. The maximum distance between the acceptor and host is 50 feet (15 meters). Cabling between the acceptor and host should be of good quality, shielded construction, and routed away from any potential source of noise or interference.
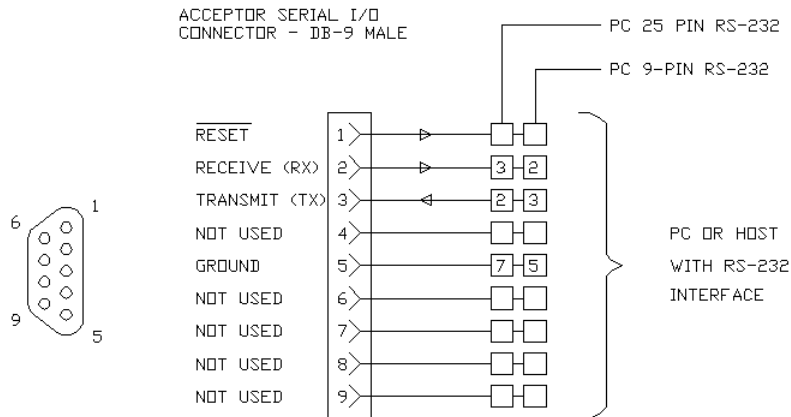
Figure 3-1
RS-232 Link for Host-Acceptor Communication.

3.3   Understanding "CREDIT" and "VEND"

To avoid the possibility of loss through premature product vending, "CREDIT" and "VEND" must be acted upon correctly by the host system software. CREDIT indicates that the acceptor has validated the note, and is waiting for a response from the host whether to collect the note or return it to the customer. A VEND signal from the acceptor means that the acceptor has validated a note and driven it out for collection. To eliminate the possibility of improper vending and loss of the note, it is important that product be issued based only on the status of the VEND signal.

CAUTION

Product should be only vended based on the status of the VEND signal, not CREDIT. Vending on the basis of CREDIT may result in loss of the product and the note.

The use of CREDIT and VEND, with or without escrow mode or stacker, depends on how the host has initialized the acceptor. At power-up, the host sends the acceptor appropriate configuration commands in response to a "CFRQ" (Configuration Request) from the acceptor. Normal mode with stacker disabled is the default when the serial acceptor powers up. For escrow mode, the host must send the acceptor an "ESCROW" command. For operation with a stacker, the host must send the acceptor a "STACKEN" (Stacker Enable) command. In the following descriptions, the actions of the host system reflect what the host software must do in order to communicate with the acceptor.

3.3.1   VEND in "Normal" Mode

In this acceptor, normal mode can be used with or without a stacker. The default mode is operation without a stacker.

In Normal mode without stacker, the acceptor processes the note, and if it is valid, immediately drives the note out for collection. The acceptor then issues a VEND signal to the host to show that the note has been validated and collected.

If a stacker is used, the note momentarily remains in the acceptor after validation while the acceptor issues a CREDIT ("POSITION") signal directly to the stacker through the stacker I/O port. This signal sets up the stacker punch mechanism for the incoming note. When the stacker is ready, it sends a STACKER READY back to the acceptor. The acceptor issues a VEND and sends the note to the stacker where it is punched into the existing note stack.

In normal mode, the acceptor does not send a CREDIT message to the host at any time. The customer has no means of canceling the vend; the acceptor returns the note only if it cannot be validated.

3.3.2   CREDIT and VEND in "Escrow" Mode

"Escrow" mode is a selectable feature of the note acceptor which enables the host (or customer) to decide on disposition of the note. Escrow mode can be used with or without a stacker. The host can enable the acceptor for either mode at power-up in response to the acceptor's "CFRQ" (Configuration Request).

When escrow mode is enabled, the acceptor processes the note, and if it is valid, holds the note as it sends a CREDIT message to the host. CREDIT informs the host that the note is valid and in escrow. If a stacker is used, the acceptor also issues a CREDIT ("POSITION") signal directly to the stacker through the stacker I/O port. This signal sets up the stacker punch mechanism for the incoming note. The acceptor then waits for a response from the host. If a stacker is connected, the acceptor must also receive a "STACKER READY" from the stacker in order to collect the note.

The host-to-acceptor command set provides the host two responses to CREDIT: "RETURN NOTE" and "CREDIT TAKEN". A "RETURN NOTE" from the host reverses the acceptor and sends the note back to the customer. If the host sends CREDIT TAKEN to the acceptor and a stacker is not used, the acceptor drives the note out for collection. If a stacker is connected, the acceptor must also receive a "STACKER READY" signal from the stacker before it drives out the note.

When the acceptor drives out the note, it sends the host a VEND message. If a stacker is connected, the acceptor also issues a VEND ("PUNCH") to the stacker through the stacker I/O port. The stacker then presses the note into the existing note stack and the acceptor is ready for another note.

3.3.3   Power-Down VEND Protection in Escrow Mode

This acceptor provides Power-Down Vend Protection when operated in escrow mode. When the acceptor validates a note, it sends a CREDIT signal to the host. The host must send back a CREDIT TAKEN signal to collect the note.

If power is lost after the acceptor begins driving the validated note out for collection, the acceptor will remember receiving the CREDIT TAKEN, and then assess the position of the note when power is restored. If the note still covers the "note present" sensor when power is restored, the acceptor returns the note to the customer and cancels the vend cycle. If the note has been driven beyond the "note present" sensor, the acceptor completes the drive-out when power is restored and then issues a VEND to the host.

3.4   Cleaning and Maintenance

Bank note handling devices will normally build up a film of oil and dirt from the bank notes themselves. If excess dirt builds up on the transport drive belts, wheels, or sensors, poor acceptance will result. The note path should be cleaned at least once a year. More frequent cleaning may be required depending on the location and usage of the equipment. A more detailed cleaning procedure is outlined later in this manual.

CAUTION

Use only 99% isopropyl alcohol to clean the transport mechanism. Oil-based solvents will attack rubber parts, causing premature failure. Aggressive aromatic solvents will attack or melt plastic components and paint.

4

Installation

4.1   Introduction

This section will assist you in the following operations:

1.   Supplying operating power to the serial acceptor.

2.   Connection of the acceptor to the host system

3.   Connection of a stacker into the system

4.2   Acceptor Power Requirements

The serial acceptor requires the following supply voltages, which are applied to the indicated pin numbers on connector J1:

J1 PIN NUMBER	VOLTAGE	CURRENT
1	+5V DC	1A
2	+24Vdc	500Ma
3	DC GROUND	—————

The power is supplied through a dedicated power connector on the acceptor.

The +24Vdc supply operates the acceptor motor, while +5Vdc supply powers logic within the acceptor. This acceptor contains an internal regulator, which supplies +15Vdc from the +24Vdc supply. The serial driver/receiver device on the I/O board internally produces the negative supply voltage needed for the serial communication link.

4.3   Stacker Power Requirements

ARDAC Brand stackers require +24Vdc or 24Vac, depending on the stacker. If a stacker is used, it can be powered from the power supply used for the acceptor (if it is a DC stacker), or from a separate supply.

Typical current requirements for the stacker are approximately 300mA operating or 500mA peak during stall. Consult your stacker documentation for details.
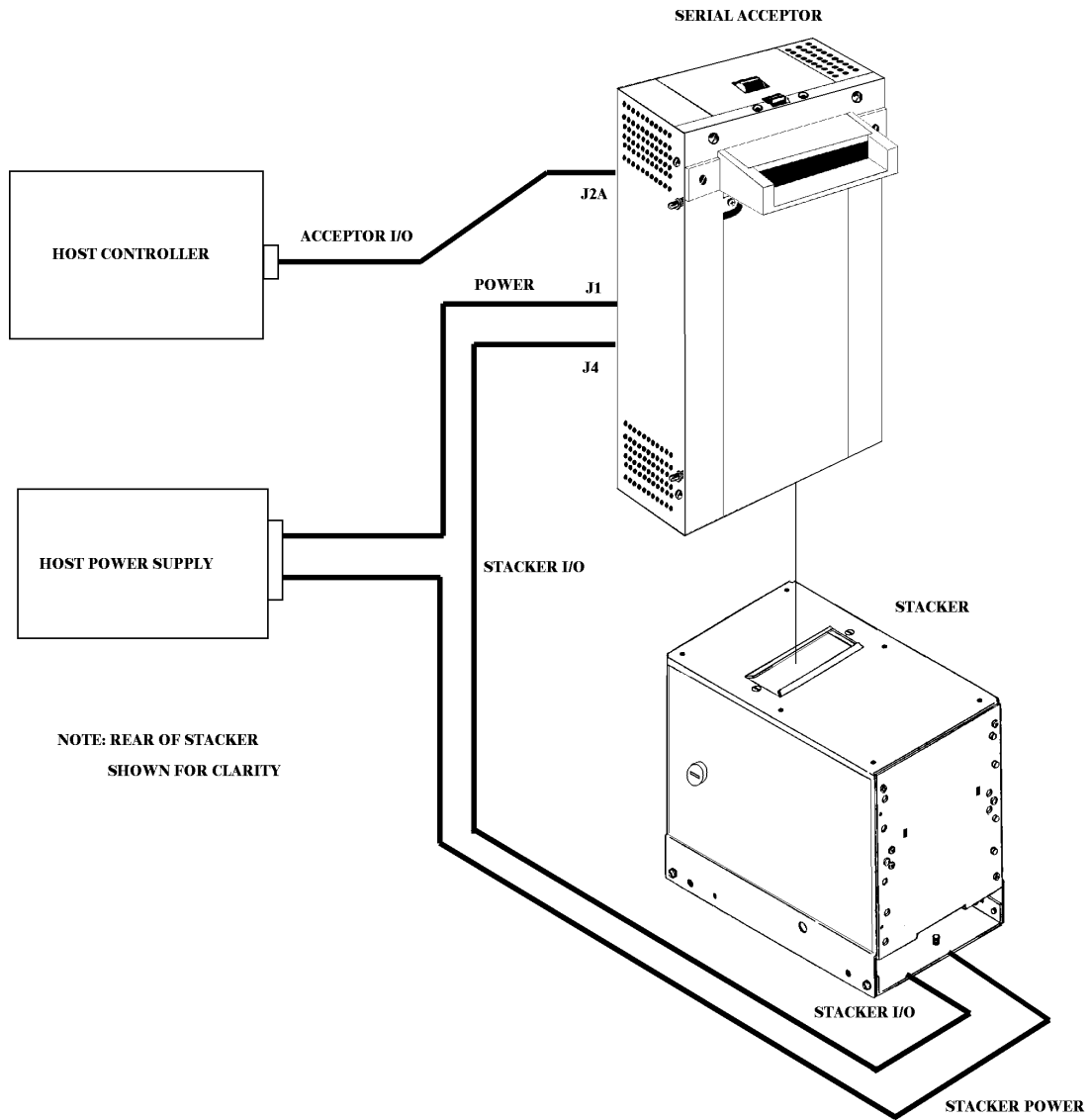
Figure 4-1
Connection - Acceptor, Stacker, Host, and Power
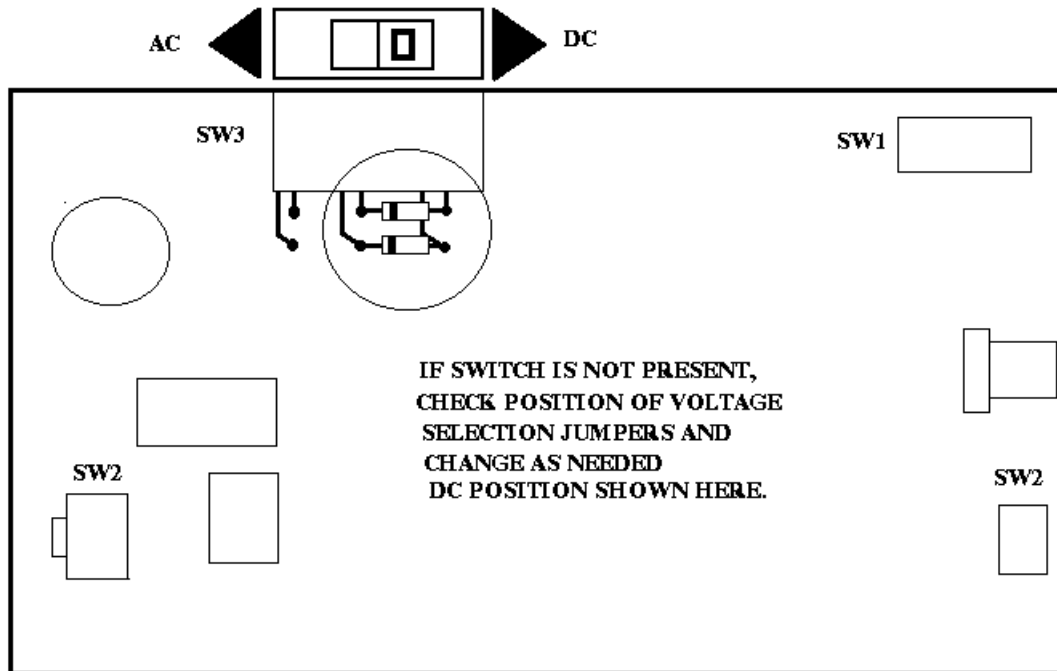
Figure 4-2
AC/DC Selection for Typical
ARDAC "B" or "C" Type Stacker.

4.4   Mechanical Installation

The acceptor frame includes four mounting studs, which are designed to slide into a mating cradle in the host. The note escutcheon should not support the acceptor's weight. Ideally, the front of the escutcheon should be flush with the host's front panel. If the acceptor is improperly installed, stress may be placed on the escutcheon, leading to escutcheon breakage or misalignment of the note path. Figure 4-3 shows a possible mounting method.

HOST NOTE
ENTRANCE

NOTE
ESCUTCHEON

ACCEPTOR
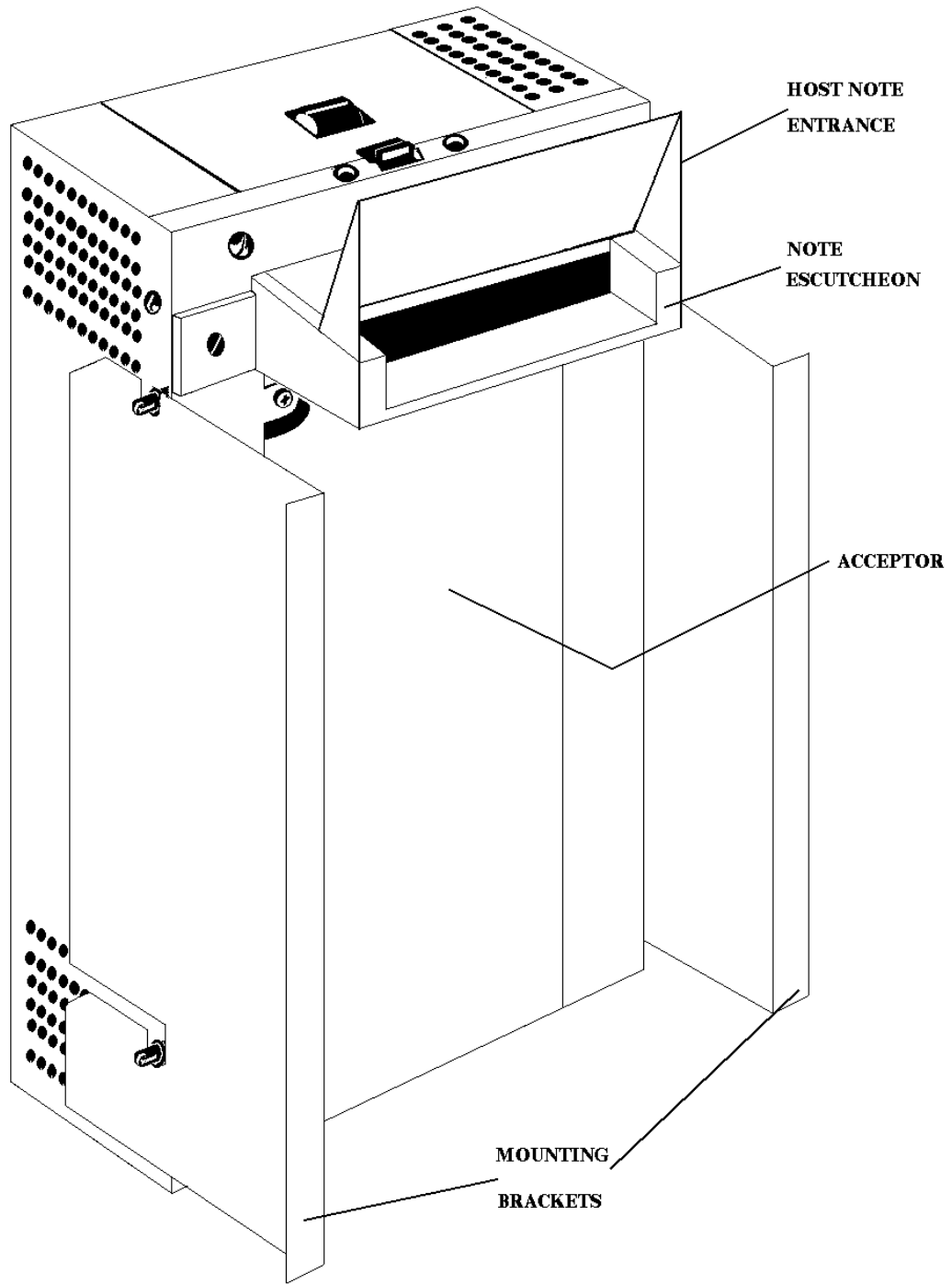
MOUNTING
BRACKETS

Figure 4-3
Typical S2000 Mounting

4.5   Acceptor Communication and Connections

The serial note acceptor communicates with the host system through an RS-232 serial interface in which the acceptor acts as Data Communication Equipment (DCE). The following descriptions assume that the host is set up to act as Data Terminal Equipment (DTE). A personal computer with standard serial port and ARDAC Host Software acts as DTE. The note acceptor serial I/O connector is a DB-9P, male, 9-pin, D-shell type.

Communication is 11 bits long, consisting of one start bit, an 8-bit character, one odd parity bit, and one stop bit at a rate of 1200 baud.

Separate connectors are used for power, host-acceptor communication, and acceptor-stacker communication (see Figures 4-1 and 4-4).

4.6   HOST-ACCEPTOR I/O SIGNALS (I/O BOARD CONNECTOR J2A)

RESET   (Pin 1): The RESET input is a low-true external signal, which causes the acceptor microprocessor to restart. The RESET signal can be implemented through a hardware switch or low-true logic signal from the host.

                 The microprocessor board for this acceptor includes a "watchdog" circuit which resets the processor in the event normal operation is not maintained. The watchdog circuit is selected by installing jumper JH on the microprocessor board. Jumper JL selects the long timeout period (i.e., 1-2 seconds), while jumper JK selects a short timeout (a few hundred milliseconds).

                 The I/O board in this acceptor includes a power supply monitor which generates a reset during power-up or if supply voltage drop below specified levels. The reset circuit is selected through jumper JE on the acceptor I/O board.

                 If the internal reset is enabled, the external reset (pin 1) has no effect.

RX   (Pin 2): The Receive (Rx) line on the acceptor connects to the Rx line of the host or a PC used as a host simulator. Since the acceptor acts as DCE, data flows out of the acceptor's Rx pin into the host's Rx pin.

TX   (Pin 3): The Transmit (Tx) line on the acceptor connects to the Tx line of the host or a PC used as a host simulator. Since the acceptor acts as DCE, data flows from the host's Tx pin into the acceptor's Tx pin.

GROUND   (Pin 5): The GROUND pin acts as circuit common for the Tx and Rx lines.

NOT USED: (Pins 4, 6, 7, 8, 9): These pins are not used by this acceptor.

4.7   STACKER-ACCEPTOR I/O SIGNALS
(I/O BOARD CONNECTOR J4 Refer to Figure 4-5)

OPTO +15 VOLTS   (Pin 3) and OPTO GROUND (Pin 2): The OPTO +15V and OPTO GROUND provide
                      drive current for the diode side of the optical isolators on the stacker.

STACKER READY   (Pin 4): The STACKER READY signal is a low-true logic level generated by the stacker
                      microprocessor during note acceptance. It indicates that the stacker punch mechanism is
                      positioned and the stacker is ready to accept a note from the acceptor.

CR2   (Pin 5): The CREDIT 2 signal should be wired to the stacker's POSITION 2 or CREDIT
                      2 input (different names for the same stacker input pin). This signal causes the stacker to
                      move its internal punch to accept and stack a note in Side 2 of the stacker. CR2 occurs
                      when the acceptor sends a serial CREDIT command to the host. The host must respond
                      with CREDIT TAKEN for the acceptor to issue a VEND.

VEND 1   (Pin 7): The VEND 1 signal should be wired to the stacker's PUNCH 1 or VEND 1 input
                      (different names for the same stacker input pin). This signal causes the stacker to punch
                      the note into the existing note stack on Side 1 of the stacker. VEND 1 occurs when the
                      acceptor sends a serial VEND command to the host.

VEND 2   (Pin 8): The VEND 2 signal should be wired to the stacker's PUNCH 2 or VEND 2 input
                      (different names for the same stacker input pin). This signal causes the stacker to punch
                      the note into the existing note stack on Side 2 of the stacker. VEND 2 occurs when the
                      acceptor sends a serial VEND command to the host.

CR1   (Pin 9): The CREDIT 1 signal should be wired to the stacker's POSITION 1 or CREDIT
                      1 input (different names for the same stacker input pin). This signal causes the stacker to
                      move its internal punch to accept and stack a note in Side 1 of the stacker. CR2 occurs
                      when the acceptor sends a serial CREDIT command to the host. The host must respond
                      with CREDIT TAKEN for the acceptor to issue a VEND.

UNUSED   (Pins 1 and 6): These pins are unused by the acceptor. Pin 6 acts as a key.
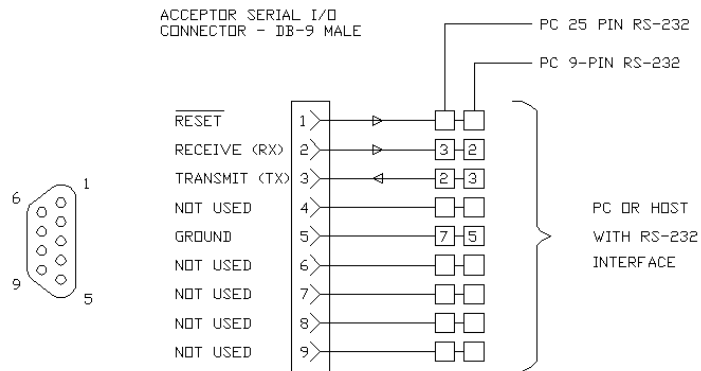
Figure 4-4
Acceptor Serial I/O Connector
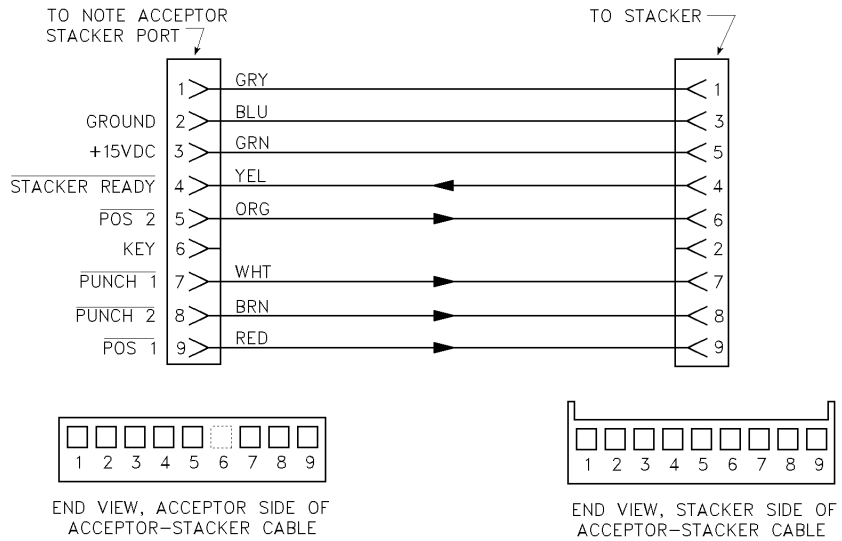
Figure 4-5
Stacker I/O Connector
J4 on I/O board

ACCEPTOR POWER SUPPLY   (I/O BOARD CONNECTOR J1)

+5V (Pin 1): Connection point for +5Vdc.

+24Vdc (Pin 2): Connection point for +24Vdc.

DC GND (Pin 3): Connection point for common of all supply voltages.

CHASSIS GND (Pin 4): Connection point for chassis ground.

ACCEPTOR
POWER CONNECTOR

J1

+5VDC	1	
+24VDC	2	TO POWER SUPPLY
DC GND	3	
CHASSIS GND	4	

Pin 1 +5V

Pin 2 +24V

Pin 3 DC GND

Pin 4 Chassis GND
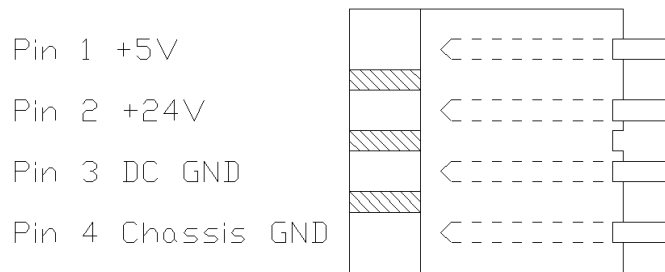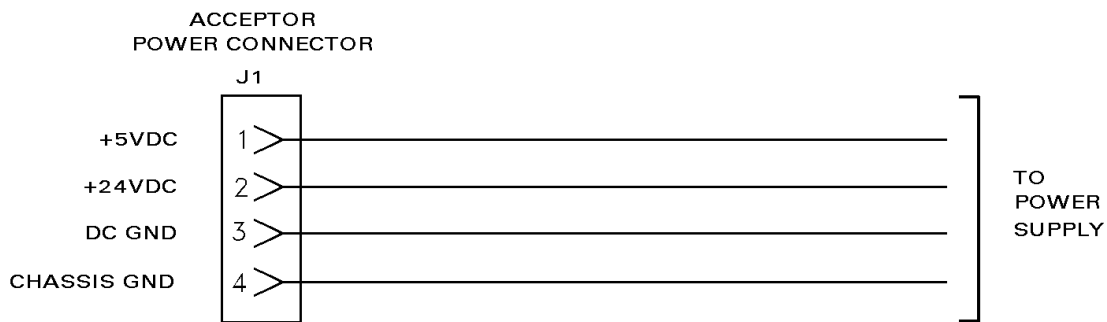
J1 on I/O Board

NOTE:

CHASSIS GROUND IS NOT CONNECTED TO POWER SUPPLY GROUND INSIDE THE ACCEPTOR. TO MAINTAIN ISOLATION BETWEEN THESE GROUNDS, POWER SUPPLY COMMON OR GROUND SHOULD REMAIN SEPARATE FROM CHASSIS GROUND AT THE POWER SUPPLY.

Figure 4-6
Power Supply Connections
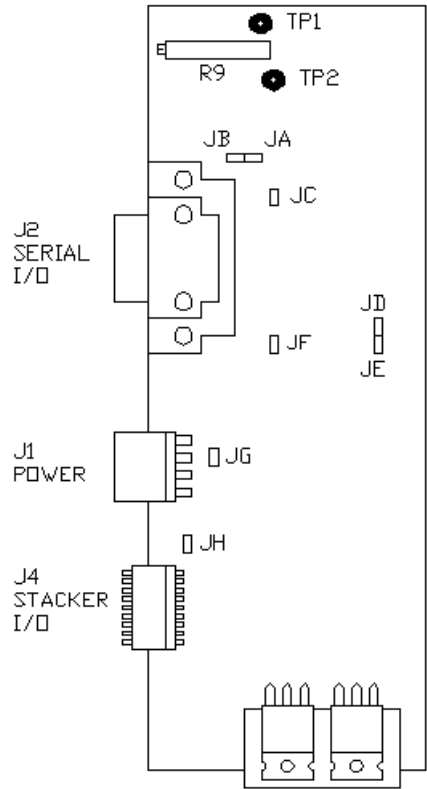
JUMPERS A, C, E, AND H INSTALLED

Figure 4-7
I/O Board Connections

4.8 Acceptor Jumpers and DIP Switches

On power-up, the acceptor defaults to inhibiting of all notes. The acceptor's operating mode, accepted notes, etc. are configured through software commands which must be sent by the host to the acceptor at power-up. Refer to later chapters of this manual for details on Setup mode.

The microprocessor board contains two sets of dip switches. Their functions are shown in Table 5-6.

To reconfigure the jumpers, remove the left side cover from the acceptor, locate the jumper bank, and install the jumper in the desired position.

I/O BOARD JUMPERS INSTALL JUMPERS A, C. E. AND H

Table 4-1. 88x2500-x Configuration Jumpers

5

<u>Serial Interface Specification</u>

5.1   Communication Protocol

In normal operation, the note acceptor is treated as a slave, and will never initiate communications. The host (i.e. the device communicating with the note acceptor) must initiate all dialogue between itself and the note acceptor.

The host should "poll" the note acceptor on a routine basis. A polling interval of approximately 100 milliseconds is recommended for the following reasons:

A.   It provides a frequent check that the note acceptor and communication link are functioning properly.

B.   It provides for timely response of the note acceptor, permitting the acceptor to input notes without any apparent delays.

The host software should include a time-out check on all responses from the note acceptor. If no response is received from the note acceptor within five seconds, the note acceptor or communications link should be assumed out of order.

5.2   Host-Acceptor Dialogue

Essentially, there are four types of dialogue that can occur between host and the note acceptor:

1.   Idle
2.   Command from note acceptor to host
3.   Command from host to note acceptor
4.   Diagnostic or error message transfer from note acceptor to host.

5.2.1   Idle

Most of the time, the acceptor will be idle. During idle time, the host should periodically send the acceptor a POLL. message to determine whether the acceptor has received a note or has any other pending messages. (A 100ms interval is recommended.) Since the acceptor is idle, it will simply respond with an acknowledge (ACK) message. The exchange is very simple:

```
                         POLL
    ┌────────┐  ──────────────────────▷  ┌────────┐
    │        │                           │        │
    │        │                           │ NOTE   │
    │  HOST  │                           │ ACC.   │
    │        │          ACK              │        │
    │        │  ◁──────────────────────  │        │
    └────────┘                           └────────┘
```
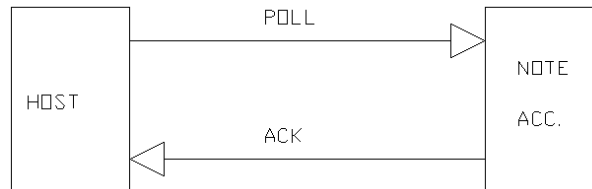
During idle, the acceptor constantly checks for a note insertion between the times it is engaged in the POLL/ACK exchange. In this way, the acceptor will draw notes in only if the communications link remains intact.

5.2.2   Command From Note Acceptor to Host

If the acceptor receives a poll from the host and has a message for the host (CREDIT, VEND, etc.), or a change in status to report (JAM, BUSY, etc.), the exchange looks like this:

```
                          POLL
    ┌────────┐  ──────────────────────▷  ┌────────┐
    │        │                           │        │
    │        │  COMMAND OR STATUS CHANGE  │ NOTE   │
    │  HOST  │  ◁──────────────────────  │ ACC.   │
    │        │                           │        │
    │        │          ACK              │        │
    │        │  ◁──────────────────────  │        │
    └────────┘                           └────────┘
```
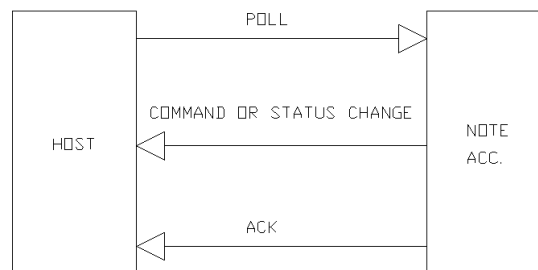
The acceptor responds to the host's POLL. by sending the pending message. The host should process the response. If the response is correctly received and recognized, the host should respond to the acceptor with an ACK.. If the command is unintelligible or appears invalid, the host should respond with a Negative Acknowledgement (NAK.).

As a general rule, the host must respond to any command from the note acceptor by returning an ACK. or a NAK.. The note acceptor keeps track of the number of times it receives a NAK.. After one NAK., the acceptor retransmits the command. If the acceptor receives two NAK.s in a row, the acceptor resets itself and issues a CONFIGURE REQUEST (CFRQ.) command to the host. The host should then reinitialize the acceptor by issuing the appropriate series of INHIBIT and ACCEPT commands to the acceptor, as it does during power-up initialization. After each command during initialization, the host must wait for an ACK. from the acceptor.

5.2.3   Command From Host to Note Acceptor

If the host has a command for the note acceptor (for instance, a change in INHIBIT/ACCEPT status) and a
POLL is due out to the note acceptor, the host can simply issue the command instead of the POLL. The
exchange resembles the following:
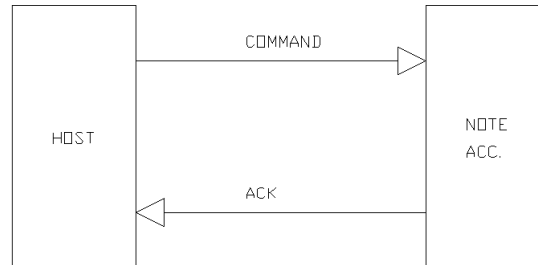
The acceptor responds to the host's message by sending an ACK. if the response was correctly received,
recognized, and executable. The ACK. does not necessarily signify completion of the command, merely
acceptance and beginning of execution. If the command is unintelligible or appears invalid, the acceptor
responds to the host with a Negative Acknowledgement (NAK.).

The note acceptor keeps track of the number of consecutive times it sends a NAK.. If it sends one NAK.,
the host should retransmit its message. If the acceptor responds with another NAK., it immediately resets
itself and sends the host a CONFIGURE REQUEST (CFRQ) command. The host should then reinitialize
the acceptor by issuing a series of INHIBIT and ACCEPT commands to the acceptor, as it does during
power-up initialization. After each command, the host must wait for an ACK. from the acceptor.

There is one restriction on commands from the host to the note acceptor. If the debug mode is in effect,
then the host should insert a POLL. between successive commands to the acceptor to insure that any error
messages coming from the acceptor are recovered. If this is not done, nothing harmful results. However, all
error messages from the acceptor except the first will be lost. The exchange is as follows:
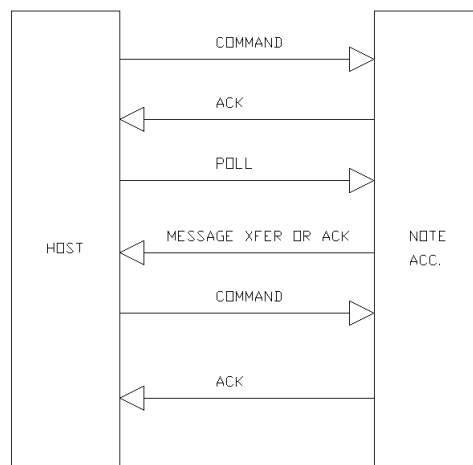
5.2.4 Diagnostic or Error Message Transfer

When polled, the note acceptor may respond with an ERR. command indicating that a diagnostic or error message follows. If the acceptor is operating in debug mode, the error message will consist of an acceptor error code (see Table 5-8) plus a string of diagnostic values.

When a PC is used with ARDAC's Host Simulator software, these messages are displayed on the PC's screen. The messages contain status and diagnostic information about the note acceptor and last transaction.

When the host receives an ERR. message from the acceptor, it must poll the acceptor for each succeeding byte of the message, as shown in the following diagram. The host should continue the process until it receives an End-of-Error message (ENER.) from the acceptor, signifying termination of the message.
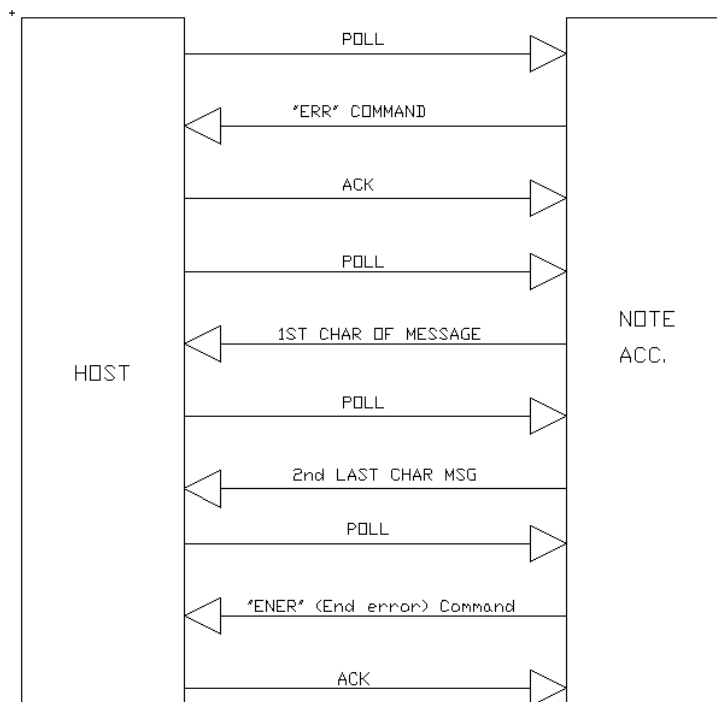
5.3   Error Recovery

If the host detects a parity, framing, or any other communication error, it should respond to the acceptor with a NAK.. The acceptor will attempt to resend its last message. If the host improperly receives the message again, it should respond with another NAK.. The acceptor keeps track of the number of NAK.s received, and after two NAK.s, responds with a request for configuration (CFRQ.).

If the host receives a NAK. from the note acceptor, it should resend the command last sent to the acceptor. If the acceptor improperly receives the message again, it will respond with another NAK. and immediately send a request for configuration (CFRQ.).

In either of these situations, the host should retry the operation twice and, and if a CFRQ. is received, reinitialize the acceptor.

If the host determines that the note acceptor is at fault, the host can attempt to recover the acceptor by issuing a RESET. command. If the acceptor recovers, it will automatically issue a request for configuration. After the host reinitializes the acceptor, the acceptor should return to normal operation if it is in good working order..

5.4   Valid Commands and Errors

The following tables provide a comprehensive list of valid commands between the host and serial acceptor as initiated by each device. Note that all commands may not be used on all acceptor models. Table 5-8 is a listing of error conditions.

Table 5-1. Command List – Host to BNA – <u>Standard Commands</u>

Command (ASCII) [HEX]	Description
(♣) [05]	Poll (POL)
(♠) [06]	Acknowledge (ACK)
(!) [21]	Negative Acknowledge (NAK)
(I) [49]	Debug enable
(J) [4A]	Debug disable
(K) [4B]	Escrow mode on
(L) [4C]	Escrow mode off
(M) [4D]	Credit Taken
(N) [4E]	Return Note
(O) [4F}	Disable Extended Diagnostic CAPS Mode
(P) [50]	Inquire (Verbose diagnostic message)
(Q) [51]	Enable Extended Diagnostic CAPS Mode
(R) [52]	Reset (RST)
(S) [53]	Magnetic Head Test Enable
(T) [54]	Magnetic Head Test Disable
(\) [5C]	Stacker Enable
(/) [2F]	Stacker Disable

Table 5.2 - Command List - Host to BNA - <u>Denominational commands</u> (ASCII) [HEX]

Denomination	Inhibit	Accept 4-Direction Normal Security	Accept 4-Direction High Security	Accept 2-Direction High Security
10,000 Lire	(A) [41]	(a) [61]	(i) [69]	(q) [77]
50,000 Lire (old issue)	(B) [42]	(b) [62]	(j) [70]	(r) [78]
50,000 Lire (new issue)	(C) [43]	(c) [63]	(k) [71]	(s) [79]
5 Euro	(D) [44]	(d) [64]	(l) [72]	(t) [80]
10 Euro	(E) [45]	(e) [65]	(m) [73]	(u) [81]
20 Euro	(F) [46]	(f) [66]	(n) [74]	(v) [82]
50 Euro	(G) [47]	(g) [67]	(o) [75]	(w) [83]
Reserved	(H) [48]	(h) [68]	(p) [76]	(x) [84]

Lire ON	(X) [58]
Euro ON	(Y) [59]

'X' and / or 'Y' must be issued in response to the BNA's request for reconfigure 'C'

Table 5.3 –   Command List – Host to BNA – <u>Test Mode commands</u> (Must be enabled
                    by a dipswitch)

Command (ASCII) [HEX]	Description
(1) [31]	Motor On
(2) [32]	Motor Off
(3) [33]	Motor On – Forward Direction
(4) [34]	Motor On – Reverse Direction
(5) [35]	TNT Lamps On
(6) [36]	TNT Lamps Off
(7) [37]	Solenoid On (energized)
(8) [38]	Solenoid Off (de-energized)
(<) [3C]	Magnetic Head Set-Up Mode Enabled
(>) [3E]	Magnetic Head Set-Up Mode Disabled

**Shaded areas represent: new, changed, or previously undefined commands from earlier
specification for Italian S2000 Serial BNA FW 57x421 and 57x873.**

Table 5.4. – Command List – BNA to Host – <u>Standard Commands</u>

Command (ASCII) [HEX]	Description
(♦) [04]	End of Transmission (EOT) – Text error message end
(♣) [05]	Poll (POL)
(♠) [06]	Acknowledge (ACK)
(•) [07]	Bell (BEL) – Text error message start
(!) [21]	Negative Acknowledge (NAK)
(B) [42]	BNA Busy
(C) [43]	Request for reconfigure
(I) [49]	BNA Idle
(J) [4A]	Note Jam
(R) [52]	Note Rejected (Optional – See Dipswitch Bank 2, switch 5)
(S) [53]	Stacker Failure

Table 5.5 – Command List – BNA to Host – Denominational Commands

Denomination	Vend (ASCII) [HEX]	Credit (ASCII) [HEX]
10,000 Lire	(1) [31]	(5) [35]
50,000 Lire (old & new)	(2) [32]	(6) [36]
5 Euro	(3) [33]	(7) [37]
10 Euro	(4) [34]	(8) [38]
20 Euro	(D) [44]	(T) [54]
50 Euro	(E) [45]	(U) [55]
Reserved	(F) [46]	(V) [56]

Shaded areas represent: new, changed, or previously undefined commands from earlier specification for Italian S2000 Serial BNA FW 57x421 and 57x873.

Table 5.6   Dip Switch Bank 1 (CFGSW1)

Switch #	Function	Description
1	ON	10,000 Lire accepted
	OFF	10,000 Lire inhibited
2	ON	50,000 Lire accepted
	OFF	50,000 Lire inhibited
3	ON	5 Euro accepted
	OFF	5 Euro inhibited
4	ON	10 Euro accepted
	OFF	10 Euro inhibited
5	ON	20 Euro accepted
	OFF	20 Euro inhibited
6	ON	50 Euro accepted
	OFF	50 Euro inhibited
7	---	Undefined (spare)
8	---	Undefined (spare)

Table 5.7   Dip Switch Bank 2 (CFGSW2)

Switch #	Description	
1	Undefined (spare)	
2	Undefined (spare)	
3	Off = Euro Accept / On = Euro Inhibit	
4	ON	Lire Inhibited
	OFF	Lire Accepted
5	ON	Enable 'R' command on rejected note
	OFF	Disable 'R' command on rejected note
6	ON	ROM Select = EPROM
	OFF	ROM Select = FLASH
7	ON	Reserved
	OFF	Reserved
8	ON	Enable "test mode" commands
	OFF	Disable "test mode" commands
Dip switch inhibit functions will always override serial command inhibits.		

Table 5.8   Note Acceptor Error Codes, by Hex Byte Value

0x01	Trigger was not reached in time
0x02	Note transport is missing tachs
0x03	Motor is stalled
0x04	2nd note in transport
0x05	Transport jammed
0x06	Object was in the transport
0x07	Note is over legal length
0x08	Note is under legal length
0x09	Density autozero out of limits
0x0A	Note position control error
0x10	Vendor disabled
0x11	Note not allowed to be taken
0xC0	Correlation error
0X70	Math process timeout error
0x20	Top vis/ir over limit error
0x21	Top ir/1 over limit error
0x22	Bot vis/ir over limit error
0x23	Bot ir/1 over limit error
0x24	Top sum over limit error
0x25	Bot sum over limit error
0x26	Vis/ir sum over limit error
0x27	Ir/1 sum over limit error
0x28	Total sum over limit error
0x29	MAG test 1 under limit error
0x2A	MAG test 1 over limit error
0x2B	MAG test 2 under limit error
0x2C	MAG test 2 over limit error
0x2D	Density over limit error
0x2E	Left vs right mismatch error
0x2F	First vs second mismatch error
0X30	Drive out error
0x31	Vendor response timeout
0X32	Protocol timeout error
0x40	Stacker not home
0x41	Stacker error
0x42	Stacker punch error
0x80	Check sum exception
0x81	Internal ram exception
0x82	External ram exception

5.5   Sample Transactions

Following are a few examples of the most common serial communication exchanges. Most messages consist of a single byte as described in the preceding charts. The exception is an error sent in debug mode, which consists of several individual bytes. In this case, the host must repetitively poll and retrieve each byte individually. The following sample transactions use the terms "byte", "command", and "message" interchangeably. The messages themselves (POLL, ACK, .etc.) are transmitted between the host and acceptor as numeric byte data (0-255 decimal or 0-FF hexadecimal).

5.5.1   Note Acceptor Configuration

When powered up, the serial acceptor is inhibited from accepting any notes. The host should execute a configuration sequence at power-up, or when the acceptor requests a reconfigure, to enable the acceptance of the desired note(s) and any other desired features.

The following example shows the exchange for enabling escrow mode, disabling stacker operation, turning off debug mode, and enabling the acceptance of Notes 1 and 2. The actual mix of inhibits or accepts depends on the intended purpose of the host program, and on the notes the acceptor's software will process.

Note that the host indicates the end of configuration by sending a POLL.. The acceptor responds with an IDL. message which the host must ACK.. At the point, configuration is complete and the host can enter the standard POLL/ACK. sequence of the idle phase.

CONFIGURATION SEQUENCE

Host	Acceptor
ESCROW	
	ACK
STACKDS	
	ACK
NODEBUG	
	ACK
ACC1	
	ACK
ACC2	
	ACK
INH3	
	ACK
INH4	
	ACK.
POL	
	IDL
ACK	
POL	
	ACK

5.5.2   Idle

After configuration, the acceptor enters the idle phase. During idle, the host should periodically poll the
acceptor to verify the integrity of the serial link. To do so, the host sends a POLL.message and waits for an
ACK. message from the acceptor.

IDLE SEQUENCE

Host	Acceptor
POL	
	ACK.

5.5.3 Acceptor-Host Commands

When the host polls the acceptor, it may receive an ACK. if the acceptor is idle, or some other message if
the acceptor has a note in acquisition or has detected an error. Most messages from the acceptor consist of a
single byte, which the host simply evaluates and acts upon. If the byte is an ACK,. the host will typically
poll the acceptor again. If the byte is an ERR., the host should then shift to an error retrieval routine to
recover the rest of the error message.

ACCEPTOR-TO-HOST SEQUENCE

Host	Acceptor
POL.	
	command char
ACK.	

5.5.4   Host-Acceptor Commands

Host-to-acceptor communication is used to configure the acceptor, and to control the acceptor during note
acceptance, system adjustments, and diagnostics. Normally, the acceptor will respond with an ACK. to any
byte sent by the host. The only character that the host sends which is not acknowledged by an ACK. is a
NAK.

HOST-TO-ACCEPTOR SEQUENCE

Host	Acceptor
Command char	
	ACK.

5.5.5 Note-taking in Escrow Mode

The following sequence shows the exchange during note acceptance when the acceptor is operating in escrow mode. The acceptor reports that it is busy (BSY.), followed by a CREDIT 2 (CR2). message when it validates and places the note in escrow. The host should respond to the CREDIT message with either a CREDIT TAKEN (CRDTKN.) or a RETURN NOTE. If the acceptor escrow timeout feature is enabled, the acceptor must respond within 10 seconds or the acceptor will automatically return the note to the customer.

If the host commands the acceptor to take the note, the acceptor responds with a VEND command (VND2) when the note is collected. The acceptor then sends an IDL message at the end of the note cycle, indicating that it is done processing the note.

If a stacker were used in this example, the acceptor would send a separate CREDIT ("POSITION") command to the stacker when it sends a CREDIT to the host. The acceptor would then require a STACKER READY from the stacker before it could respond to a CREDIT TAKEN from the host. As part of stacker operation, the acceptor also sends a VEND ("PUNCH") command to the stacker when it sends VEND to the host. The acceptor-stacker communication takes place over separate lines between the acceptor and stacker, and occurs simultaneously with the serial communication.

During acceptance, BSY, CR2, VND2,. and IDL. are expected in the order shown below:

NOTE TAKING SEQUENCE

Host	Acceptor.
POL	
	ACK
POL	
	BSY
ACK	
POL	
	ACK
POL	
	CR2
ACK	
CRDTKN	
	ACK
POL	
	ACK
POL	
	VND2
ACK	
POL	
	IDL
ACK	

5.5.6   Rejected Note

If a note is rejected, the acceptor follows the BUSY message with a REJECT (REJ.). message and automatically returns the note. The host must respond with ACK.. The acceptor will respond to the host's next POLL with an IDL, after which the host may resume the usual POLL/IDL sequence.

Rejected Note

Host	Acceptor
POL	
	BSY
ACK	

POL	
	REJ
ACK	

POL	
	IDL
ACK.	

5.5.7   Error Message

When the acceptor has an error message to report, it responds to a POLL from the host with an ERR. ERR indicates that the acceptor has a series of additional error bytes ready for transmission. The host must then repeatedly POLL the acceptor. After each POLL, the acceptor responds with another error byte. The last byte of the error string is ENER. The host must then respond with an ACK after which it may return to periodic polling of the acceptor.

ERROR TRANSMISSION SEQUENCE

Host	Acceptor
POL	
	ERR
POL.	
	char1
POL.	
	char2

	Char. N
POL	
	ENER
ACK.	

6

Using a PC to Simulate a Host

6.1 Introduction

An IBM-compatible personal computer can be used to simulate the host system. Money Controls offers a PC-compatible Host Simulator software package which enables the PC to control and communication with the acceptor. This arrangement simplifies set up, adjustment, or troubleshooting of the serial acceptor by providing a graphic, user-friendly environment.

Cabling between the PC and acceptor can be set up using only Tx, Rx, and GND conductors as shown in Table 6-1. A stacker (if present) may also be connected to the acceptor when it is operated in test and diagnostic modes.

6.2 Configuration of Acceptor and PC

The system connections necessary for using a PC as a host simulator are shown in Tables 6-1 and 6-2 and Figure 6-1.

Acceptor J2A Pin No.	I/O Function	PC 9-PIN SERIAL, PIN NO.	PC 25-PIN SERIAL PIN NO.
2	RECEIVE (RX)	2	3
3	TRANSMIT (TX)	3	2
5	GROUND	5	7

Table 6-1. Connections - Acceptor to Standard PC 9-Pin and 25-Pin Serial RS-232 Ports
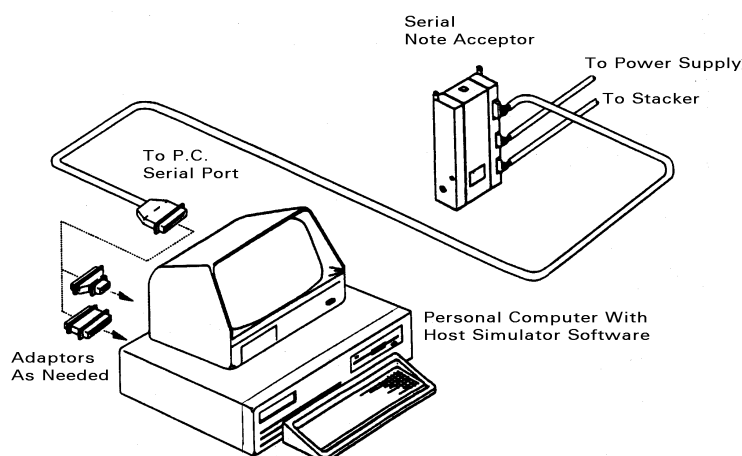
Figure 6-1. System Connections for PC Host Simulator
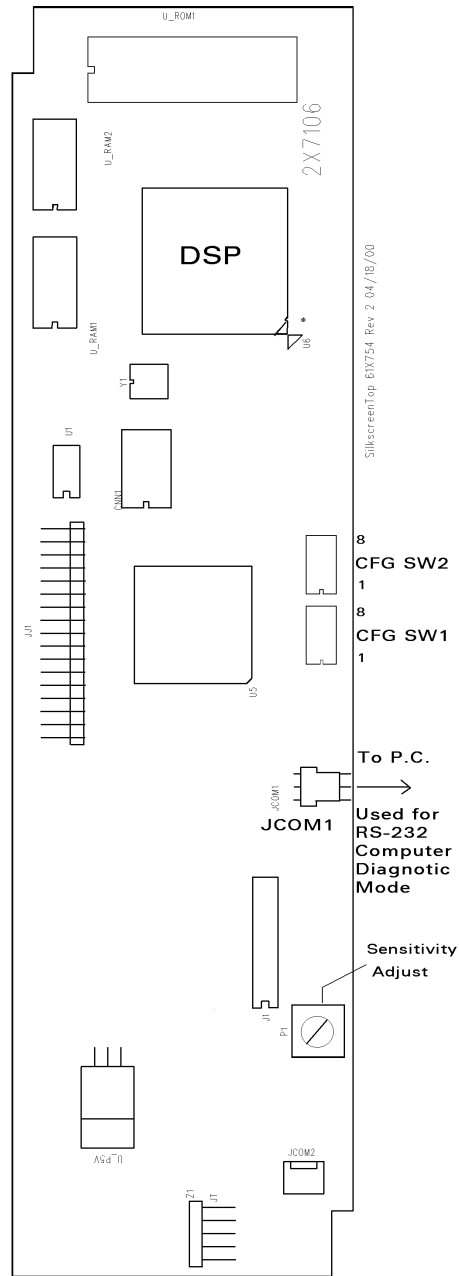
**Figure 6-2
Serial Acceptor Microprocessor Board
2X7106-X**

The acceptor can be configured to operate in setup mode by connecting diagnostic cable on JCOM1 on the microprocessor board. See Figure 7-1 and for location and use of the microprocessor board diagnostic connector.

Configure the acceptor as follows:

I/O BOARD JUMPERS: INSTALL JUMPERS A, C. E. AND H

1.   Make sure that the note acceptor power supply cord is disconnected.

2.   Locate the serial I/O connector on the note acceptor. Using a suitable cable, connect the acceptor to a serial port on the personal computer. See Table 6-1 for pin-out information. The Host Simulator software defaults to use of COM1.

NOTE

For convenience, PC COM1 is recommended for use with the Host Simulator software. The Host Simulator software defaults to using COM1. The COM port can be changed if necessary by hitting the <F3> key and then selecting "Communications Options" and selecting the appropriate communications port.

3.   Plug in the note acceptor power supply. Turn on the personal computer and acceptor power supply.

4.   Load DOS or windows in the usual way and prepare to install and run the Host Simulator software. The following protocol is used for communications between the PC and serial acceptor. These parameters will be set automatically by the Host Simulator software:

Parity enabled (odd parity),
One start bit,
One stop bit,
8 data bits,
1200 baud.

6.3   Host Simulator Software

The Host Simulator is a program for IBM PC or compatible computers, which enables the PC to act as a host for Ardac's S-2000 type serial acceptors and other serial products. This software handles the protocol used to communicate with the serial acceptor, and displays each character going in both directions on the serial link.

The Host Simulator program basically consists of two parts: the communications interface and the finite state machine that handles the protocol. When the program is in transparent (as opposed to host simulation) mode, the protocol machine is turned off.

6.4 Host Software Installation

It is possible to run the Host Simulator from a floppy diskette, in which case you should make and use a duplicate of the original. For maximum convenience and speed, running from a fixed disk is recommended.

1. To install the Host Simulator software on a computer containing a fixed disk, first create a directory (or folder in Windows) on the fixed disk (S2000 is suggested). Copy all the files from the distribution diskette to the directory. In the following examples, type the bold letters and press the <Enter> key as shown. The Host software diskette is assumed to be in drive A:

    C:\MD S2000 <Enter>
    C:\CD S2000 <Enter>
    C:\s2000> COPY A:*.* <Enter>

2. If you are running the program from a Windows 3.x or Windows 9x platform, make sure that the communications port is turned on and configured properly. Also, make sure that no other programs are using that port.

3. Some computers will require the user to restart in MS-DOS mode to allow proper operation of the host program.

4. The host program only supports COMM 1 and COMM 2 with standard IRQ and I/O address assignments.

6.5 Host Setup Files

The Host software setup files consist of COLORS.HST, COMM.HST, and a language-specific screen text file, which contains the Host Simulator software display screens. The standard text file is named "IT.HST". Other text files may be supplied for specific applications. These setup files should be in the same directory as the executable. If present, they change the initial set up of the program.

The COLORS.HST file allows the user to change the colors of the windows. A description of each line is given in the file.

COMM.HST provides the serial communication parameters, the default configuration data for the acceptor, and the name of the screen text file, which will be loaded when HOST.EXE runs. COMM.HST can be altered as described later in this section.

The screen text file contains the on-screen text for the software's command windows. This arrangement permits the program to easily be converted to different languages by simply editing the file. Care must be taken to keep all the strings in the same order and of the same general format (punctuation, etc.) as the originals. The file "IT.HST" contains display and configuration data for the 88x2500 acceptor.

FILE	DESCRIPTION
HOST.EXE	Host Simulator executable.
DEFAULT.HST	The default text strings used by HOST.EXE.
ITEU.HST	The text strings used by HOST.EXE for the 88x2500 acceptor.
COLORS.HST	The color setup file. This file is optional.

Table 6-3. List of Host Simulator Software Component Files

6.6   Running the Host Software

To run the Host Simulator software, move to the directory containing the software and type at the DOS command line:

C:\S2000\HOST

Then hit <ENTER>

A screen resembling Figure 6-3 should appear on your monitor. The host simulator software package provides the following run-time screens and displays:

```
┤ Commands - F2 for more ├
 Inhibits           4-Dir, Normal Sec  4-Dir, High Sec    2-Dir, Highest Sec
 A - INH. 10K Lire  a - ACC. 10K Lire  i - ACC. 10K Lire  q - ACC. 10K Lire
 C - INH. 50K Lire  c - ACC. 50K Lire  k - ACC. 50K Lire  s - ACC. 50K Lire
 D - INH.  5 Euro   d - ACC.  5 Euro   l - ACC.  5 Euro   t - ACC.  5 Euro
 E - INH. 10 Euro   e - ACC. 10 Euro   m - ACC. 10 Euro   u - ACC. 10 Euro
 F - INH. 20 Euro   f - ACC. 20 Euro   n - ACC. 20 Euro   v - ACC. 20 Euro
 G - INH. 50 Euro   g - ACC. 50 Euro   o - ACC. 50 Euro   w - ACC. 50 Euro

┤ From Host ├                  ┤ From Acceptor ├
Accept 20 Euro norma"f"  ACKing                         "♠"
Inhibit  50 Euro     "G"  Request for Reconfigure         "C"
Inhibit Not Used     "H"  ACKing                         "♠"
Stacker Disable      "/"  NAK                            "!"
Escrow Off           "L"  ACKing                         "♠"
Debug Off            "J"  Request for Reconfigure         "C"
POLLing              "♣"  ACKing                         "♠"

┤ Communications ├
♣♠♣♠♣♠♣♠♣♠♣♠C♠a♠c♠d♠E♠F♠G♠H♠/♠L♠J♠♣C♠a♠c♠d♠E♠F♠G♠H!H♠/♠L♠J♠♣C♠a♠c♠d♠e♠FF♠!G
♠H♠/♠L♠J♠♣C♠a♠c♠d♠e♠f♠G♠H♠/♠L♠J♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠♣♠
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    CON POL INQ A/R SIM ACC:12345̲6    1200081COM2:    1/  1  state=2
```

Figure 6-3 Host Simulator Main Screen

6.6.1   "Commands"

The "Commands" window shows the characters that a host machine might send to an acceptor. Not all characters are valid at all times. For example "1 Motor On" is not valid if the acceptor is not in debug mode. To scroll through the different pages of commands, press the F2 key. All command windows are shown in figure 6-4.

6.6.2   "From Host"

The "From Host" window shows and interprets the characters that are being sent to the acceptor. In addition to characters that the protocol part of the program generates, any character that is typed on the keyboard will be sent to the acceptor.

6.6.3 "From Acceptor"

The "From Acceptor" window shows and interprets the characters that are being received by the PC from the acceptor.

```
                        ┤ Commands - F2 for more ├
  Inhibits              4-Dir, Normal Sec  4-Dir, High Sec    2-Dir, Highest Sec
  A - INH. 10K Lire  a - ACC. 10K Lire  i - ACC. 10K Lire  q - ACC. 10K Lire
  C - INH. 50K Lire  c - ACC. 50K Lire  k - ACC. 50K Lire  s - ACC. 50K Lire
  D - INH.  5 Euro   d - ACC.  5 Euro   l - ACC.  5 Euro   t - ACC.  5 Euro
  E - INH. 10 Euro   e - ACC. 10 Euro   m - ACC. 10 Euro   u - ACC. 10 Euro
  F - INH. 20 Euro   f - ACC. 20 Euro   n - ACC. 20 Euro   v - ACC. 20 Euro
  G - INH. 50 Euro   g - ACC. 50 Euro   o - ACC. 50 Euro   w - ACC. 50 Euro
```

```
                        ┤ Commands - F2 for more ├
  K - Escrow On    L - Escrow Off    M - Credit Taken   N - Reject Note
  S - Mag Test On  T - Mag Test Off  [ - Dens Test On   ] - Dens Test Off
  U - Test 1 On    V - Test 1 Off    W - Test 2 On      X - Test 2 Off
  Y - Test 3 On    Z - Test 3 Off    ( - Test 4 On      ) - Test 4 Off
  1 - Motor On     2 - Motor Off     3 - Motor Forward  4 - Motor Reverse
  5 - TNT Lamps On 6 - TNT Lamps Off 7 - Solenoid On    8 - Solenoid Off
  9 - Mag Setup On 0 - Mag Setup Off \ - Stacker Enable / - Stacker Disable
```

```
                        ┤ Commands - F2 for more ├
  Y - Test 3 On    Z - Test 3 Off    ( - Test 4 On      ) - Test 4 Off
  1 - Motor On     2 - Motor Off     3 - Motor Forward  4 - Motor Reverse
  5 - TNT Lamps On 6 - TNT Lamps Off 7 - Solenoid On    8 - Solenoid Off
  9 - Mag Setup On 0 - Mag Setup Off \ - Stacker Enable / - Stacker Disable

  F1 - Help        F3 - Options      F4 - Show Message Window
  F5 - Quit        F6 - Reset Host   F7 - Transparent/Host Sim Mode
```

Figure 6-4 Host Simulator Software Command Windows

6.6.4 "Communications"

The "communications" window shows the characters being transferred in both directions on the serial link, interlaced with each other. This is useful for understanding the communication protocol between the acceptor and host.

6.6.5   Status Line

The bottom line of the display line shows the values of the various flags, communication parameters and state of the host simulator.

STATUS ELEMENT	MEANING
STK	The stacker is under control of the acceptor
ESC	The acceptor is in escrow mode
DEB	The acceptor is in debug mode
CON	The host will automatically reconfigure the acceptor on the receipt of a request for reconfigure
POL *	The host will periodically poll the acceptor
INQ *	The host will automatically perform an "inquire input" at a certain time.
A/R	The host, when in escrow mode, will automatically accept or reject a note in for a credit signal was received.
SIM	The host is in host simulation mode (as opposed to transparent mode).
ACC: 12345678	This shows which notes are acceptable.
1200O81COM1:	(1200/O/8/1/COM1) The baud rate, parity, bits per byte, stop bits, and com port for the serial communications.
2/3 **	The present value of the system clock (in 1/18 sec) and the time at which it will timeout waiting for some event.
STATE = 1 **	The state of the host simulation.

Table 6-4   Status Line Information

*   The POL and INQ flags in HOST.EXE version 1.0 have no function and are included for future releases.

**   The timer and state information is for host program debugging and can be ignored in most cases.

6.6.6   "Message"

The "Message" window shows the messages polled from the acceptor when the host is in simulation mode and all the communication from the acceptor when the host is in transparent mode. This window is accessed by pressing the F4 key, and hidden in the same way. While the message window is displayed, communication is still in progress.

6.7   Options Menu

The values of the flags, communication parameters, and protocol timing can be changed on the options menu. To call up the options menu, press the F3 key. Then use the arrow keys to select the desired option and press the enter or return key. Some items on the main menu have sub-menus associated with them. These are displayed when the main menu option is selected. Some of the items (such as the protocol timing constants) have fill-in-the-blanks spaces. To change this option use the arrow keys to get to the option, key in the new value and hit return. To choose none of the items on the main menu or any sub-menu, the user may "back out" of the menu by pressing the left arrow key or the <Esc> key.

6.8   Miscellaneous Notes on HOST.EXE

In HOST.EXE Version 1.0, the POL and INQ flags have no function

The windows that are hidden by the Message window are not updated while the message window is displayed.

The configuration is not savable from one running of the program to the next. This forces the user to reconfigure the host (escrow mode, baud rate, debug mode) each time HOST is run.

Sending a character that changes the acceptor in some way does NOT affect the host. For example, manually sending a "J" will turn on debug mode in the acceptor but will not set the corresponding flag in the host. This means that the host will turn debug mode back off next time it configures the acceptor.

In normal operation, the PC with the Host Simulator software will maintain correct communication with the acceptor. IF the software should appear to be in a confused state, pressing F6 will reset the system.

6.9   Serial Acceptor Command Set

The following information outlines communication between the serial acceptor and P.C. The following tables show the functions, hex values, and ASCII screen characters of the various commands. These commands are the same as those shown earlier in this manual. They differ only in arrangement. These tables list commands by function to help simplify working with the Host Simulator software.

6.9.1   Host to Acceptor Commands

When the host has a command for the acceptor, the host sends that command and expects an ACK in return. If either no response or any character other than ACK is received, the host will try to send the message twice more. The following is a complete list of commands, all of which may not be used on a specific model acceptor.

Command (ASCII) [HEX]	Description
(♣) [05]	Poll (POL)
(♠) [06]	Acknowledge (ACK)
(!) [21]	Negative Acknowledge (NAK)
(I) [49]	Debug enable
(J) [4A]	Debug disable
(K) [4B]	Escrow mode on
(L) [4C]	Escrow mode off
(M) [4D]	Credit Taken
(N) [4E]	Return Note
(O) [4F}	Disable Extended Diagnostic CAPS Mode
(P) [50]	Inquire (Verbose diagnostic message)
(Q) [51]	Enable Extended Diagnostic CAPS Mode
(R) [52]	Reset (RST)
(S) [53]	Magnetic Head Test Enable
(T) [54]	Magnetic Head Test Disable
(\) [5C]	Stacker Enable
(/) [2F]	Stacker Disable

6.9.2   Command List - Host to BNA - <u>Denominational commands</u> (ASCII) [HEX]

Denomination	Inhibit	Accept 4-Direction Normal Security	Accept 4-Direction High Security	Accept 2-Direction High Security
10,000 Lire	(A) [41]	(a) [61]	(i) [69]	(q) [77]
50,000 Lire (old issue)	(B) [42]	(b) [62]	(j) [70]	(r) [78]
50,000 Lire (new issue)	(C) [43]	(c) [63]	(k) [71]	(s) [79]
5 Euro	(D) [44]	(d) [64]	(l) [72]	(t) [80]
10 Euro	(E) [45]	(e) [65]	(m) [73]	(u) [81]
20 Euro	(F) [46]	(f) [66]	(n) [74]	(v) [82]
50 Euro	(G) [47]	(g) [67]	(o) [75]	(w) [83]
Reserved	(H) [48]	(h) [68]	(p) [76]	(x) [84]

6.9.3   **C**ommand List – Host to BNA – <u>Test Mode commands</u> (Must be enabled by a dip switch)

Command (ASCII) [HEX]	Description
(1) [31]	Motor On
(2) [32]	Motor Off
(3) [33]	Motor On – Forward Direction
(4) [34]	Motor On – Reverse Direction
(5) [35]	TNT Lamps On
(6) [36]	TNT Lamps Off
(7) [37]	Solenoid On (energized)
(8) [38]	Solenoid Off (de-energized)
(<) [3C]	Magnetic Head Set-Up Mode Enabled
(>) [3E]	Magnetic Head Set-Up Mode Disabled

6.9.4   Command List – BNA to Host – <u>Standard Commands</u>

Command (ASCII) [HEX]	Description
(♦) [04]	End of Transmission (EOT) – Text error message end
(♣) [05]	Poll (POL)
(♠) [06]	Acknowledge (ACK)
(•) [07]	Bell (BEL) – Text error message start
(!) [21]	Negative Acknowledge (NAK)
(B) [42]	BNA Busy
(C) [43]	Request for reconfigure
(I) [49]	BNA Idle
(J) [4A]	Note Jam
(R) [52]	Note Rejected (Optional – See Dip switch Bank 2, switch 5)
(S) [53]	Stacker Failure

6.9.5   Command List – BNA to Host – Denominational Commands

Denomination	Vend (ASCII) [HEX]	Credit (ASCII) [HEX]
10,000 Lire	(1) [31]	(5) [35]
50,000 Lire (old & new)	(2) [32]	(6) [36]
5 Euro	(3) [33]	(7) [37]
10 Euro	(4) [34]	(8) [38]
20 Euro	(D) [44]	(T) [54]
50 Euro	(E) [45]	(U) [55]
Reserved	(F) [46]	(V) [56]

Shaded areas represent: new, changed, or previously undefined commands from earlier specification for Italian S2000 Serial BNA FW 57x421 and 57x873.

6.10   Micro PCB Dip switch Functionality

6.10.1 Dip Switch Bank 1 (CFGSW1)

Switch #	Function	Description
1	OFF	10,000 Lire accepted
	ON	10,000 Lire inhibited
2	OFF	50,000 Lire accepted
	ON	50,000 Lire inhibited
3	OFF	5 Euro accepted
	ON	5 Euro inhibited
4	OFF	10 Euro accepted
	ON	10 Euro inhibited
5	OFF	20 Euro accepted
	ON	20 Euro inhibited
6	OFF	50 Euro accepted
	ON	50 Euro inhibited
7	---	Undefined (spare)
8	---	Undefined (spare)

6.10.2 Dip Switch Bank 2 (CFGSW2)

Switch #	Description	
1	Undefined (spare)	
2	Undefined (spare)	
3	OFF	Euro Accepted
	ON	Euro Inhibited
4	OFF	Lire Accepted
	ON	Lire Inhibited
5	OFF	Enable 'R' command on rejected note
	ON	Disable 'R' command on rejected note
6	OFF	ROM Select = EPROM
	ON	ROM Select = FLASH
7	ON	Reserved
	OFF	Reserved
8	OFF	Enable "test mode" commands
	ON	Disable "test mode" commands
Dip switch inhibit functions will always override serial command inhibits.		

Revision History: (Of Protocol Spec 44X493)

<u>Revision A</u>.   June 9, 2000 - Original proposed specification.

<u>Revision B</u>.   June 26, 2000 - Revised Host to Acceptor commands:
                     X' = Lire ON   (Previously 'X' = Lire On / Euro Off).
                     Y' = Euro ON   (Previously 'Y' = Euro ON / Lire Off).

<u>Revision C</u>.   July 10, 2000 – Revised description for X and Y commands per Revision B.

<u>Revision D.</u>   October 5, 2000 – Removed X and Y commands from Host to Acceptor commands.
                     Added Dip Switch 2-2 Return Note Hold Enable/Disable.
                     Added Dip Switch 2-3 Euro On/Off.
                     Changed Dip Switch 2-4 to Lire On/Off.

<u>Revision E.</u>   March 26, 2001 – Reversed Dip Switches.

<u>Revision F.</u>   May 30, 2001 – Changed title from Falcon to Eagle.

<u>Revision G.</u>   October 2, 2001 – Removed "Return Note Hold" feature from dip switch 2-2.

7

Diagnostics

7.1   Diagnostic (Bench) Mode Operations

With Diagnostics mode enabled, the technician can operate the System directly from the P.C. keyboard. The Windows Hyper Terminal™ software will monitor and control:

- Monitoring Note Acceptance
- Calling Up Calibration Voltages
- Controlling The Note Transport Motor
- Data gathering

The CAPS and data dump modes are for factory use.

1.   The diagnostics mode on an Eagle S2000 can be accessed by connecting a diagnostic interface cable between the acceptor and a computer serial port. There are two types of serial cables:

   9 pin cable   2X7229 (Shown Below)
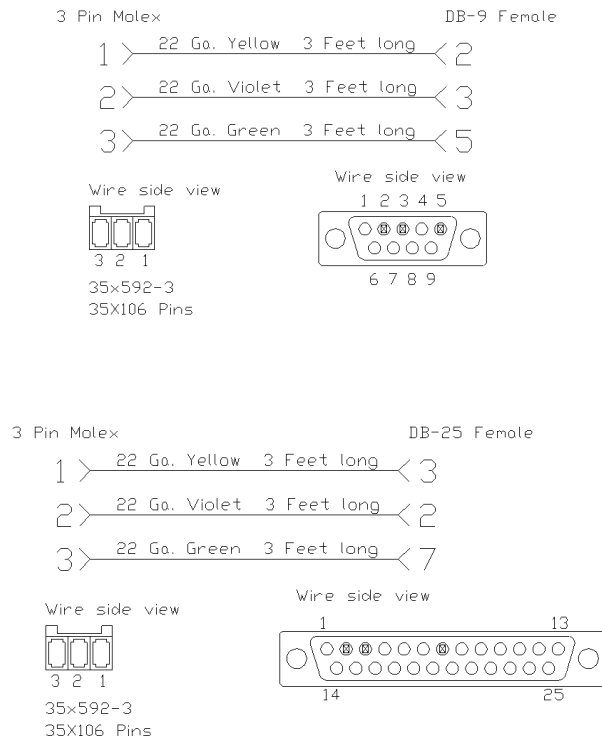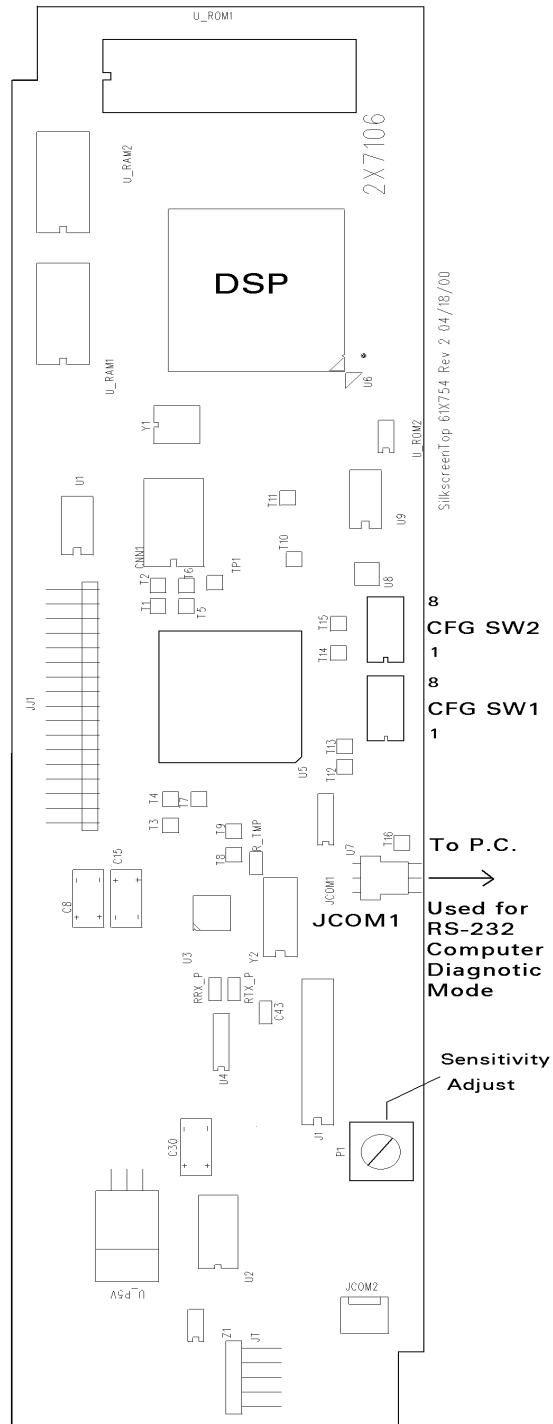   25 pin cable   2X6805 (Shown Below)

Figure 7-1
Diagnostic Cable

Figure 7-2
S2000 Eagle Micro Board Diagnostic Connection

The switches on the microprocessor board should be set as follows:

	1	2	3	4	5	6	7	8
SW-1	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
SW-2	OFF	OFF	OFF	OFF	OFF	OFF*	OFF	**ON**

*   SW2-6 Off for EPROM memory device
*   SW2-6 On for FLASH memory device

Table 7-1

A serial communications program such as Windows Hyper Terminal set to **9,600 baud, odd parity, 8 data bits and one stop bit** should be used to access the diagnostics mode. After the S2000 completes power-up, the screen display the following:

```
57x2010.05-020.04.01 (85FE)
88x2500-20
(C) 2001 ARDAC Inc.

Ready to enter diagnostics mode.
```

2.   Enter Diagnostic (Bench) mode by hitting <ESC> <ESC> <ESC> <ENTER>
      The screen should show something similar to the following:

```
Copyright (c) ARDAC Inc. 2001
Firmware PN:  57x2010.05-020.04.01
Model: 88x2500-20
Country:  ITALY

checksum = 85FE

Bench mode: ENABLED
CAPS mode: DISABLED
Data Grabbing( 60 ): DISABLED
```

3.   Hitting the <ENTER> key by itself while in diagnostics will display information similar to the above display.

4.   Valid commands for diagnostics mode are as follows:

Command	FUNCTION
<ESC><ESC><ESC><ENTER>	**Enter Diagnostics mode**
C	**caps dump**
D	**data dump**
Q	**quick dump**
V	**auto zero voltage dump**
1	**set motor on**
2	**set motor off**
3	**set motor forward**
4	**set motor reverse**
5	**set TNT lamps on**
6	**set TNT lamps off**
7	**set solenoid on**
8	**set solenoid off**
?	**this display**

Table 7-2. Diagnostic Control Keys

7.2   To Monitor Note Acceptance: (While in diagnostics Mode)

Each time a note is inserted in the note acceptor, the computer display will return one of two message strings.

-        If the note is accepted, the computer will display the country, denomination and in some software versions, the direction of the note.

-        If a note is inserted and then rejected, the computer will display the a message similar to the following:

Status Exception XXXX

The number following "Status Exception" will be most useful in determining the cause of the error condition or reason for note rejection. Table 7-5 shows a collection of error codes and their meaning.

7.3   To Control the Transport Motor: (While in diagnostics Mode)

To toggle the acceptor motor forward or reverse, and ON or OFF, press the numeral keys 2, 3 or 4 as shown below. The cassette must be left in place to enable these operations. If the cassette is removed, the actuator lever on the top of the Stacker Present switch must be taped down to simulate the presence of the cassette. No specific printout information will appear on the computer display.

2   (Toggle transport motor OFF)
3   (Toggle transport motor ON forward)
4   (Toggle transport motor ON reverse)

7.4   To control the TNT lamps: (While in diagnostics Mode)

To toggle the TNT lamps ON or OFF, press the keys shown below. To avoid unnecessary heating of the sensors, keep lamp ON-time to a minimum during such checks (a few seconds).

5   (Toggle TNT lamps ON)
6   (Toggle TNT lamps OFF)

7.5   Error codes

0x01	Trigger was not reached in time				**Power-up check error**
0x02	Note transport is missing tachs		**0x80**		check sum exception
0x03	Motor is stalled		**0x81**		internal ram exception
0x04	2nd note in transport		**0x82**		external ram exception
0x05	Transport jammed				
0x06	Object was in the transport		**0xFF**		NO_EXCEPT used in pulse protocol
0x07	Note is over legal length				
0x08	Note is under legal length		**0x80**		STACKER_ERR
0x09	Density auto zero out of limits		**0x40**		STACKER_FULL
0x0A	Note position control error		**0x20**		STACKER_LEVER
0x10	Vendor disabled		**0x02**		STACKER_OPEN
0x11	Note not allowed to be taken				
0xC0	Correlation error				
0X70	Math process timeout error				
0x20	top vis/ir over limit error				**Position control error message**
0x21	top ir/1 over limit error				
0x22	bot vis/ir over limit error		**0x01**		DELTA_COVER_EXC
0x23	bot ir/1 over limit error		**0x02**		MIN_TACH_COVER_EXC
0x24	top sum over limit error				
0x25	bot sum over limit error		**0x04**		MAX_TACH_COVER_EXC
0x26	vis/ir sum over limit error		**0x08**		COVER_STATE_EXC
0x27	ir/1 sum over limit error				
0x28	Total sum over limit error		**0x10**		DELTA_UNCOVER_EXC
0x29	MAG test 1 under limit error		**0x20**		MIN_TACH_UNCOVER_EXC
0x2A	MAG test 1 over limit error		**0x40**		MAX_TACH_UNCOVER_EXC
0x2B	MAG test 2 under limit error		**0x80**		UNCOVER_STATE_EXC
0x2C	MAG test 2 over limit error				
0x2D	Density over limit error				
0x2E	left vs right mismatch error				
0x2F	first vs second mismatch error				**Stacker errors**
0X30	drive out error		**0x40**		stacker not home
0x31	vendor response timeout		**0x41**		stacker error
0X32	protocol timeout error		**0x42**		stacker punch error

Table 7-3. Error Codes

7.6   Voltage display

1.   Following is a sample screen that is displayed when voltages are requested by hitting the letter "V" and the "Enter" keys:

```
Ardac OS>>> V

Top Vis Auto Voltage: 5.79 V (Before Divider),  1.93 V (After Divider)
Top Ir  Auto Voltage: 5.97 V (Before Divider),  1.99 V (After Divider)
Bot Vis Auto Voltage: 5.85 V (Before Divider),  1.95 V (After Divider)
Bot Ir  Auto Voltage: 5.91 V (Before Divider),  1.97 V (After Divider)
Density Auto Voltage: 9.50 V (Before Divider),  3.71 V (After Divider)

DIP Switch1:  1    2    3    4    5    6    7    8
             off  off  off  off  off  off  off  off
DIP Switch2:  1    2    3    4    5    6    7    8
             off  off  off  off  off   on  off   on
```

Table 7-4. Diagnostic (Bench) Mode Voltage Printout

2.   The first four voltages shown "Before Divider" should be 6 Volts ±.2V.

3.   The "After Divider" voltages for the first four voltages should be about 1/3 of the "Before Divider" Voltages.

4.   The "Density Auto Voltage" should be set to 9.5 V±.2V.

5.   The "After Divider" voltages for the "Density Auto Voltage" should be the "Density Auto Voltage" divided by 2.5.

6.   The last four lines display the current settings of the dip switch banks on the DSP micro board.

7.   If sensor adjustment is required, please refer to section 8 of this manual for procedure.

8

Adjustment and Cleaning

8.1   When to Adjust

All ARDAC brand bill acceptors are adjusted and tested prior to shipment, and are ready to be put into service as received. When you install the acceptor, you should routinely verify the acceptor with a few notes of each denomination the system is designed to accept.

You should only need to recalibrate the acceptor if:

1.   The acceptor has been repaired.

2.   The adjustments have been moved accidentally.

3.   The acceptor is on a schedule of preventive maintenance, which includes a check of adjustments.

If an acceptor that has been working properly suddenly begins rejecting notes, it probably requires troubleshooting and repair, not re-calibration.

The following instructions demonstrate use of the Windows Hyper Terminal™ software for checkout and adjustment of the serial acceptor's TNT, MAG, and density sensors. These adjustments are made on the note acceptor's sensor and MAG buffer boards. During these adjustments, the Windows Hyper Terminal™ software will display the voltages on the computer screen.

8.2   Adjustment of TNT, Magnetic, and Density Sensors

For proper acceptance, the serial note acceptor's sensors must be adjusted to obtain specific voltages at various test points. Adjustment of the note acceptor uses the PC and Windows Hyper Terminal™ software to control the acceptor sensors. To adjust the serial acceptor's TNT, magnetic, and density sensors, proceed as follows:

1.   Turn off power to the note acceptor. Connect the PC and note acceptor as described in Section 6 of this manual.

2.   Remove the front, rear and side covers from the note acceptor to gain access to the test and adjustment points.

3.   Turn on the PC and note acceptor power.

4.   Refer to Figure 8-1, Microprocessor Board. Configure the acceptor with a switch 2-8 on. The acceptor is now in "test mode".

5.   Refer to Figure 8-2, Sensor Board, and locate the 11-pin test point bank TP1-TP11. Test point #1 is labeled on the sensor board with a "1". Test point TP11 is system ground.

6.   Follow your usual procedure for booting the computer and then run Window's Hyper Terminal.™

7.   Connect the ground lead of a voltmeter to TP-11. Set the voltmeter to a range suitable for measuring 0-15 VDC.

8.   Set the DENSITY voltage level by adjusting potentiometer R30 for a voltage of 9.5V ± 0.2V at TP10).

9.   Once the screen displays "Ready to enter diagnostics mode", hit <ESC> <ESC> <ESC> then <ENTER>.

10.   Turn on the TNT lamps by pressing the "5" key on the keyboard.

CAUTION

To protect the acceptor lamps and filters from possible damage, do not leave the TNT lamps on any longer than necessary. Typing "5" on the keyboard will turn on the lamps.
Typing "6" on the keyboard will turn off the lamps.

11   Set the TOP VIS voltage level by adjusting potentiometer R42 for a voltage of 6.0V ± 0.2V at TP9).

12   Set the TOP IR voltage level by adjusting potentiometer R43 for a voltage of 6.0V ± 0.2V at TP8).

13   Set the BOT VIS voltage level by adjusting potentiometer R41 for a voltage of 6.0V ± 0.2V at TP7).

14   Set the BOT IR voltage level by adjusting potentiometer R5 for a voltage of 6.0V ± 0.2V at TP6).

To set the MAG gain pot: (While in diagnostics)

1.   Type "3" on the PC keyboard. The transport motor will turn on in the forward direction.

2.   Turn on the MAG test by hitting the ">" key.

3.   Adjust the MAG potentiometer R10 (Figure 8-3) fully clockwise. The Windows Hyper Terminal™ software should now print a string of "B"s indicating that the MAG head is detecting electrical noise.

4.   Adjust the MAG potentiometer R10 counter-clockwise until "B"'s are no longer displayed on the screen.

5   Adjust the MAG potentiometer R10 counter-clockwise 30° more (1 hour on a clock face).

6.   Connect the (+) lead of a voltmeter to TP-2 on the I/O board. Set the voltmeter to a range suitable for measuring 1 VDC (see Figure 8-4).

7.   Adjust R9 on the I/O board until the voltmeter reads 0.95 VDC (see Figure 8-4).

8.   Disconnect the voltmeter and reassemble the acceptor.

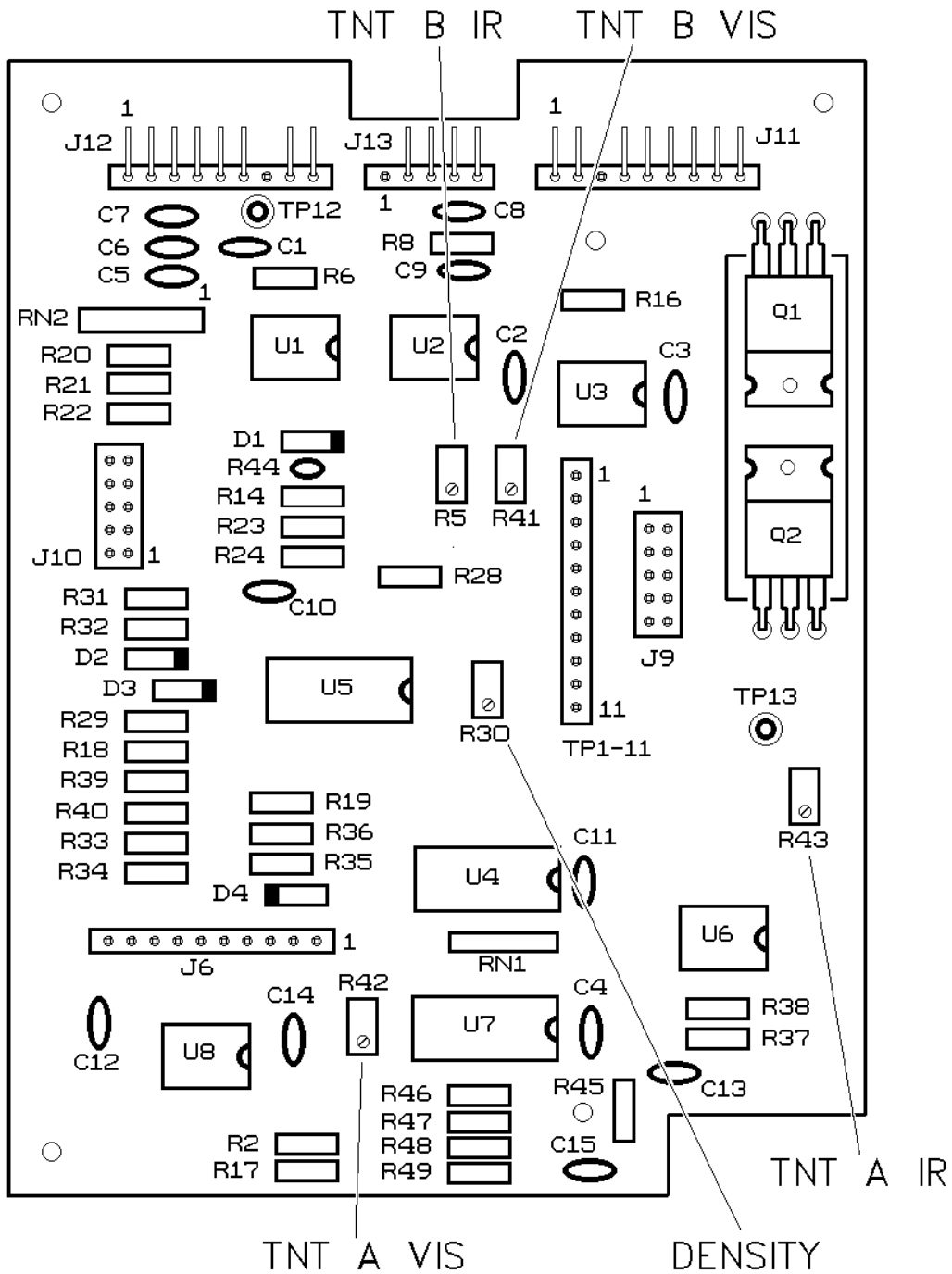This completes adjustment of the acceptor's sensors.

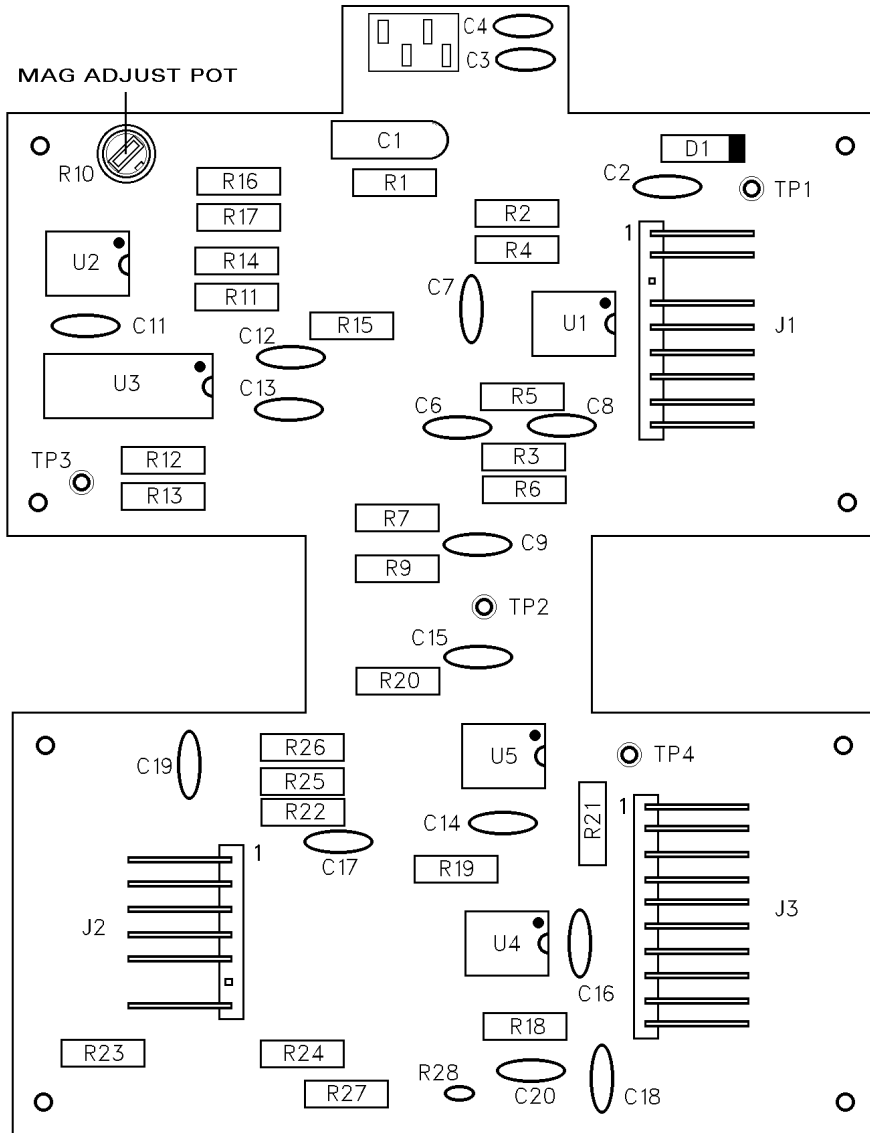**Figure 8-1. Microprocessor Board**

Figure 8-2
Sensor Board
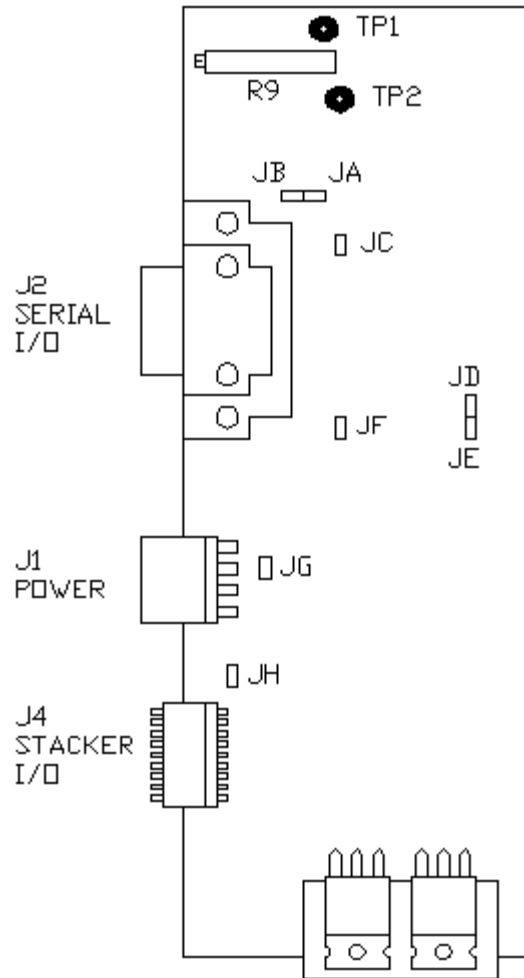
Figure 8-3
MAG Buffer Board

Figure 8-4

I/O Board (JUMPERS A, C, E, AND H INSTALLED)

8.3   Sensitivity Adjustment Procedure

The acceptor is factory adjusted to accept 99% of all good notes in circulation. The mid range (1:00) of the sensitivity pot typically represents this setting. This adjustment is made at the factory at the time of production and should not need any further attention.

The percentage of old and worn notes can be increased or decreased according to specific requirements. To change the percentage of acceptance, refer to the microprocessor board layout for location of the sensitivity adjustment control. The right hand side cover has a round access hole for adjustment of the pot.

To change the acceptance:

1.   Refer to Figure 8-1. The sensitivity potentiometer is adjusted at the factory to the 1:00 position (the range is 8:00 to 4:00)

2.   Turn the sensitivity potentiometer counter-clockwise to decrease acceptance.

3.   Turn the sensitivity pot clockwise to increase acceptance.

8.4   Escutcheon Adjustment

An entrance escutcheon is standard equipment on the note acceptor. It is mounted on adjustable nuts to permit alignment of the note entrance. This adjustment is made at the factory at the time of production and should not need any further attention. If the escutcheon shifts during shipment or handling, readjust it as follows:

1.   Loosen the two screws on either side of the escutcheon.

2.   Realign the slot in the escutcheon with the slot in the acceptor and tighten the screws.

3.   Test the acceptor with a few notes. If necessary, repeat steps 1 and 2.

8.5   Cleaning

Bank note handling devices will normally build up a film of oil and dirt from the bank notes themselves. If excess dirt builds up on the transport drive belts, wheels, or sensors, poor acceptance will result. The note path should be cleaned at least once a year. More frequent cleaning may be required depending on the location and usage of the equipment.

CAUTION

Use only 99% isopropyl alcohol to clean the transport mechanism. Oil-based solvents will attack rubber parts, causing premature failure. Aggressive aromatic solvents will attack or melt plastic components and paint.

Cleaning of the note acceptor uses the Windows Hyper Terminal™ software to control the acceptor motor. Instructions are as follows.

1.   Turn off power to the note acceptor. Connect the PC and note acceptor as described in Section 6 of this manual.

2.   Remove the right side cover from the note acceptor to gain access to the microprocessor board.

3.   Refer to Figure 8-1, Microprocessor Board, and note the location of the dip switches jumpers. Set switch 2-8 to the ON position. The acceptor is now in setup mode.

4.   Turn on the PC and note acceptor power.

5.   Follow your usual procedure for booting the computer and then run Hyper Terminal™. After Hyper Terminal™ starts and diagnostics mode is entered, press "1" to turn on the acceptor motor, and "3" or "4" to set the motor in forward or reverse motion.

6.   Open the acceptor by pressing the latch button located at the top of the acceptor, near the escutcheon. Swing the rear cover open to expose the transport wheels and sensors (Figure 8-5). Observe that a wheel and two sensors are located near the note entrance.

7.   Liberally apply drops of isopropyl alcohol to the transport wheels while using a cotton swab to soak up the contamination. Continue the cleaning until all dirt is removed from the wheels. Repeat the procedure for the mating rollers in the cover.

8.   Use a cotton swab moistened with isopropyl alcohol to clean the TNT sensor gray scales and window surfaces. Use a dry swab as needed to dry the area. Carefully inspect the gray scales and windows for scratches, discoloration, films, or damage.

9.   Locate the four note sensor sets located near the note entrance and near the middle of the note path, on the acceptor top and bottom sensor plates. Use a cotton swab moistened with isopropyl alcohol to clean the sensor windows, and the matching windows in the cover.

10.   Close the acceptor. Soak a strip of bond paper with isopropyl alcohol. Run the wet bond paper through the transport to clean the note path. Run a dry strip of bond paper through the transport to dry the note path.

11.   Press "2" to turn off the motor.

12.   Open the acceptor. Wipe the entire note path and escutcheon with a lint-free cloth.
13.   Return the jumper on the acceptor microprocessor board to the original position and replace the side cover.

14.   Close the acceptor and test its operation with a few notes of each type the unit accepts.
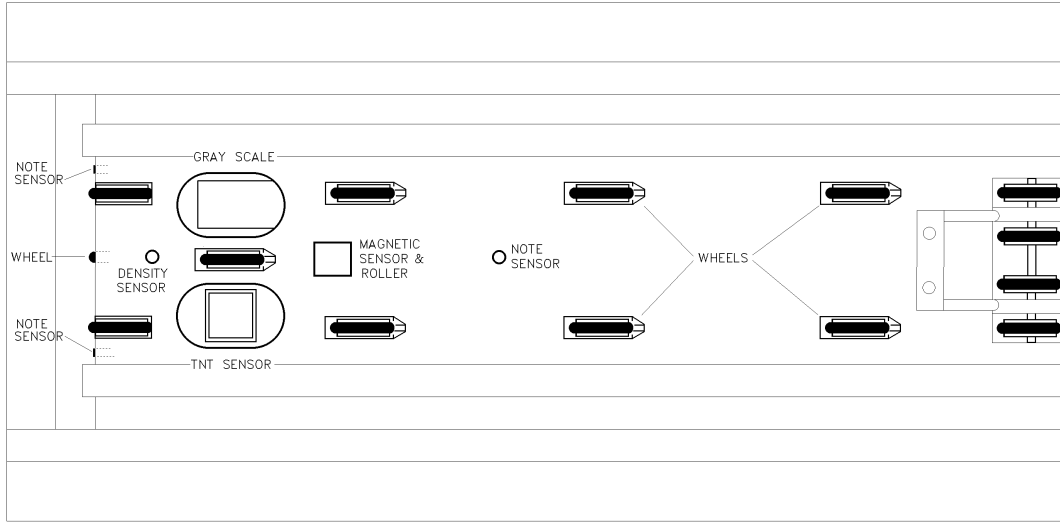
Figure 8-5
S-2000 Cleaning Areas.

9

Diagrams and Parts List

9.1   Interconnect Diagram

Number	Description
43x1204	Note Acceptor Interconnect Schematic

9.2   PC Board Subassemblies

Number	Description
2x7106	Microprocessor Board
2x5710-1	I/O and Power Supply Board
2x5821-1	Sensor Board
2x5851	Buffer Board

9.3   PC Board Schematics

Number	Description
43x1173	Microprocessor Board
43x823	I/O and Power Supply Board
43x839	Sensor Board
43x842	Buffer Board

9.4   Software Version

Number	Description
57x2010.05-20.xx.xx	EPROM with software