Dijit® 5000 Series Printers
THEORY OF OPERATION

5120/5240/5122 Printers

Scitex Digital Printing, Inc.

FCC Compliance Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Note: Good quality, shielded (braided shielded) cables must be used for the RS-232-C and Centronics interfaces.

Canadian EMI Compliance Statement

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

EMI-CISPR 22/EN 55 022/CE Marking

Warning: This is a Class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.

Dijit® 5000 Series Printers *Theory of Operation*, *5120/5240/5122 Printers*

Part Number	Revision	Date	Description	ECN
0113846	001	04/01	Extracted from 0113851 and revised for the 5122 printer	PKG938

0113846 06/2001 Printed in U.S.A.

Scope

Theory of operation provides general, technical background for the following Scitex Dijit® 5000 Series products:

- 5120 Printer and Printing System
- 5240 Printer and Printing System
- 5122 Printer and Printing System

This guide is part of the following service manual set:

- Volume 1 (0113902-001)
  Theory of Operation (0113846)

  Service Guide (0113864)
- Volume 2 (0113902-002)
  Illustrated Parts List (0113783)

  Service Diagrams (0113874)

  Installation Guide (0113847)

The information in this guide is intended only for a Scitex field engineer, or a service technical trained by Scitex Digital Printing, Inc.

Text Notations

This manual uses the following typographical conventions.

This style	Refers to
Ready	Text displayed by the software.
go	Anything you type, exactly as it appears, whether referenced in text or at a prompt.
ENTER	Special keys on the keyboard, such as enter, alt, and spacebar.
[NEXT]	Buttons and lights on the printer operator panel.
Save	Software command buttons and sections of dialog boxes, such as group boxes, text boxes, and text fields; specific components of the software, such as menu bars, tool bars, and palettes.
File → Open	A menu and a specific menu command.
ALT+F1	Pressing more than one key at the same time.
ALT, TAB	Pressing more than one key in sequence.
xx,yy	Variable in error messages and text.
jobfile.dat	File names.

Safety Notations

The following definitions indicate safety precautions to the operator.

Note: Information that needs to be brought to the reader's attention.

Caution: A situation where a mistake could result in the destruction of data or system-type damage.

WARNING
A potential hazard that could result in serious injury or death.

DANGER
An imminent hazard that will result in serious injury or death.

Service and Support

Technical equipment support is available 24 hours a day, 7 days a week.

Software and applications support is available 8:00 a.m. to 5:00 p.m. EST/EDT, Monday through Friday.

	Phone	Fax
U.S.A. and Canada Field/Telephone support	1-800-4SCITEX (1-800-472-4839)	+1-937-259-3386
Europe Field/Telephone support	+4121-806-0404	+4121-806-1920
Asia/Pacific Rim Field/Telephone support	+65-744-6400	+65-744-6700
Japan Field/Telephone support	+81-3-3256-2613	+81-3-3256-2616
Worldwide Technical support, order placement, documentation, and product information requests	+1-937-259-3739	+1-937-259-3808
Worldwide Automated FaxBack™ Information Line	+1-937-259-3520	
Internet Updated service information	http://www.scitexdpi.com	

The above telephone number listing is accurate as of the publication date. On the Internet, go to *http://www.scitexdpi.com/support* for updated telephone numbers.

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Chapter 1. Overview

General knowledge of the following subjects is necessary to effectively troubleshoot and repair Dijit 5000 Series products:

- Inkjet printing basics
- Component functions
- Functionality and reliability

Inkjet Printing Basics

Inkjet printing is the process of placing small drops of ink onto a printing surface in a pattern that produces an image. The type of inkjet printing used in the Dijit series is continuous-flow, binary, multiple-jet array imaging. Continuous inkjet printing requires the following four elementary forces:

- Pressure
- Stimulation
- Charge
- Vacuum

How these forces interact in an inkjet printhead is best understood by "building" a printhead and describing how the major printhead components harness these forces to create a printed, inkjet image.

Pressure

Pressure is produced by the ink pump that moves ink from the ink tank (supply) to the drop generator in the printhead. Printhead pressure, also called "bar pressure," is measured in pounds per square inch (psi). Pressure must be sufficient to force ink through the orifices to create filaments, but not excessive. Low pressure results in ink starvation at the printhead. Complete loss of pressure prevents printing because no ink is available to form jets. Excessive pressure can cause an internal leak or ink spill. Normal operating pressure is about 9.5 psi in the 5120 and 5122 printers and about 19 psi in the 5240 printer.

Stimulation

Stimulation is produced in the printhead by mechanical action of the droplet generator. Piezoelectric crystals are bonded to the droplet generator and excited. The resulting sinusoidal wave form produces vibration communicated to the orifice plate. The vibration breaks up the ink filaments passing through the jets into uniform drops.

Stimulation is measured by frequency. The 5120 and 5122 printers use a stimulation frequency of 50 kilohertz (kHz); this creates 50,000 ink drops per second at each jet. The 5240 printer uses 100 kHz stimulation frequency that creates 100,000 drops per second at each jet.

The correct stimulation frequency setting, typically called the “stim” setting, is critical to proper printhead operation and must be determined for the printhead by test printing. To achieve the proper stim setting, phase and voltage are adjusted within a range called a “window.”

Prolonged over-stimulation causes printhead short-circuits (shorts), print voids and eventually damage to the printhead electronics. Under-stimulation causes streakers, dark areas (ink saturation), and eventually printhead failure. Total stim failure prevents printing, as all jets stay in catch and no ink reaches the substrate. Stimulation failures are rare, but the usual cause is a bad resonator or crystal that requires replacing the printhead.

Charge

The Dijit 5000 Series printers use electrical charge to designate which droplets are to reach the printing surface. When they leave the orifice plate tunnels, the ink jets carry no electrical charge. As the jets fall toward the printing surface and break into drops, they pass close to the charge plate and catcher. The charge plate can have either a positive charge (+100 to +180 volts DC) or no charge. Formatted print data (a bit map) from the character generator controls the charge on the charge plate and determines the droplets to be used for printing.

A positive charge on the charge plate induces a negative charge in the droplets as they break away from the jet. The negatively charged droplets are attracted by the positive charge plate. This attraction changes the trajectory of the droplets, causing them to hit the catcher.

If the charge plate has no charge, the ink remains electrically neutral when it forms droplets. The neutral droplets fall past the charge plate and catcher and hit the printing surface. Total charge failure results in an ink dump, all jets printing constantly which quickly saturates the substrate. Excessive charge causes high-voltage shorts and prolonged high voltage can etch the charge leads and damage the printhead.

The 5120 charge plate contains 128 charge areas, one for each jet. The charge on each area can be changed quickly enough to selectively pass or deflect each of the 50,000 droplets passing it each second; thus, charge allows the 5120 printer to control 6,400,000 drops per second.

The 5240 and 5122 charge plates contain 256 charge areas and passes or deflects each of the 100,000 droplets, allowing these printers to control 25,600,000 drops each second.

Vacuum

Vacuum recovers and recirculates deflected drops. Charged drops hit the catcher face as they fall past the charge plate. Vacuum draws the ink on the catcher back into the fluid system where it is returned to the ink tank. Vacuum also assists the fluid system in maintaining the ink supply. As ink is used, ink or replenisher is drawn from the appropriate bottle into the tank. Vacuum failure results in ink collecting in the printhead. Excess ink in the printhead housing will eventually result in leaks or shorts.

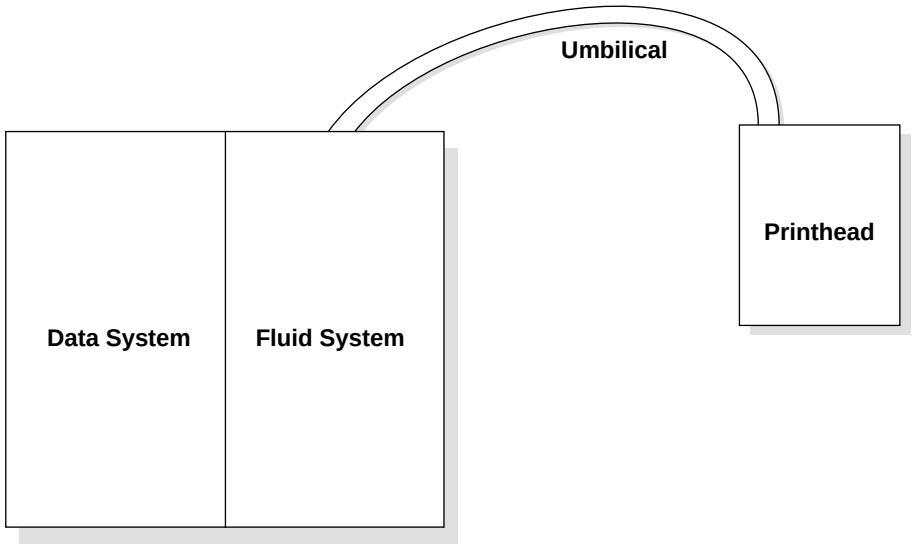
Component Functions

The basic functions of the following printer sub-systems are described:

- Printhead
- Umbilical
- Fluid system
- Data system

The printer enclosure physically contains the fluid system and data system. The umbilical connects the printhead to the enclosure. See Figure 1.1.

Figure 1.1 Printer components



The controller PC, software, and interfaces are the major components of a printing system that contains a Dijit 5000 Series printer. Printing system functions are described in Chapter 3.

Printhead Functions

Dijit 5000 Series printers have the following printheads:

- 5120 Printhead
  This 120-jet array prints 1.06 inches (2.69 cm) wide with vertical resolution of 120 dots per inch (dpi) and horizontal resolution of 120 or 240 dpi.
- 5240 Printhead
  This 240-jet array prints the same width as the 5120, but at a vertical resolution of 240 dpi, and a horizontal resolution of 240 dpi or 480 dpi.
- 5122 Printhead

This 240-jet array prints 2.133 inches (5.42 cm) wide at the same resolutions as the 5120.

Note: Vertical resolution is along the print array. Horizontal resolution is in the direction of substrate movement.

Operation is a combination of the following features of these printheads:

- Common printing sequence
- Internal differences

Common Printing Sequence

The following sequence shows how the four basic elements required for inkjet printing (shown in **bold**) are created by the major printhead components (shown in *italic*) to form a printed image.

1. The core of the printhead is a rectangular metal block, the *resonator,* mounted on a rigid frame. The resonator has an internal cavity with a narrow opening in one side. This opening faces toward the printing surface, or substrate.

2. The opening in the resonator is covered by an *orifice plate* made of thin, copper-plated nickel with a linear *array* of *orifices.*

   Higher resolution requires smaller dots, so orifices in the 5120 and 5122 plates are 1.85 ± 0.06 mils in diameter (46.9 ± 1.5µm) while those in the 5240 plate are only 1.30 ± 0.04 mils (33.0 ± 1.0µm).

3. **Pressure** applied by the printer fluid system fills the resonator cavity with ink and forces the ink out through the array. The escaping ink forms *filaments,* or thin streams, one for each orifice. The entire array produces a *curtain* of continuous ink jets that would "print" a solid band of ink on the substrate.

   The solid band equals the maximum print width, 1.065 inches for the 5120 and 5240, and 2.133 inches for the 5122.

4. To control how much ink hits the substrate, the jets are broken into drops by the vibration of the *droplet generator.* This component of the resonator vibrates when high-frequency voltage stimulates piezoelectric crystals bonded to its surface.

5. Drops are formed at a rate equal to the **stimulation** frequency. The 5120 printhead operates at 50 kilohertz (kHz) and produces 6,000,000 drops per second from its 120 jets. The 5240 and 5122 printheads operate at 100 kHz and produce 25,600,000 drops per second from their 256 jets.

6. To determine which drops reach the substrate, the falling drops pass the face of a *charge plate* bonded with an electrical lead for each jet. When a positive **charge** of 100 to180 +VDC is applied to a lead, it induces a negative charge in the falling drop. Attraction to the charge plate diverts the charged drop enough to hit the *catcher* face instead of the substrate. The printer data system controls when each charge lead is energized. The sequence of charging determines the pattern of

the bitmapped image printed on the substrate. Uncharged drops fall freely, hit the substrate and form the printed image.

7. Charged drops are diverted enough to strike the catcher face and run down it. This ink is returned, or recirculated, by **vacuum** applied to the catcher. Vacuum and positive air pressure combine to keep the catcher and orifice plate free of accumulated ink. Excess ink can dry within the printhead, causing irregular drops, shorts, etching, and clogged jets.

Internal Differences

The following internal components and construction differences distinguish the current 5240 and 5122 printheads from the original 5120 and early 5240 printheads:

- An ink condensation heater was added along with a new catcher valve, printhead air inlet valve, new vacuum servos and pump.
- Printhead and ink tank temperature was increased.
- New eyelid assembly, including the eyelid seal, eyelid solenoid, and the printhead assembly itself.
- Within the printhead assembly, the top-port resonator of the 5120 and the front-port resonator of the early 520 have been replaced by a side-port resonator in the current 5240 and 5122.
- Replacement of the tab buffer board used in the 5120 by the printhead adapter board.

All these changes enhance printhead reliability. The changes are reflected in changed state tables, and pressure and stimulation changes. To enhance printhead startup reliability, jet pressure was increased to 6 psi, and 200% stim was introduced to clear crooked (misdirected) jets.

Umbilical

The flexible cord or hose containing the electrical and fluid lines for the printhead connects the printer enclosure and the printhead housing. The following lines pass through the umbilical:

Printer Electrical
- Inkjet control
- AC high-voltage (HV) supply
- Condensation heater

Printhead Electrical
- Charge driver
- Eyelid solenoid and air ingestion
- Eyelid heater

Fluidics
- Inlet (supply)

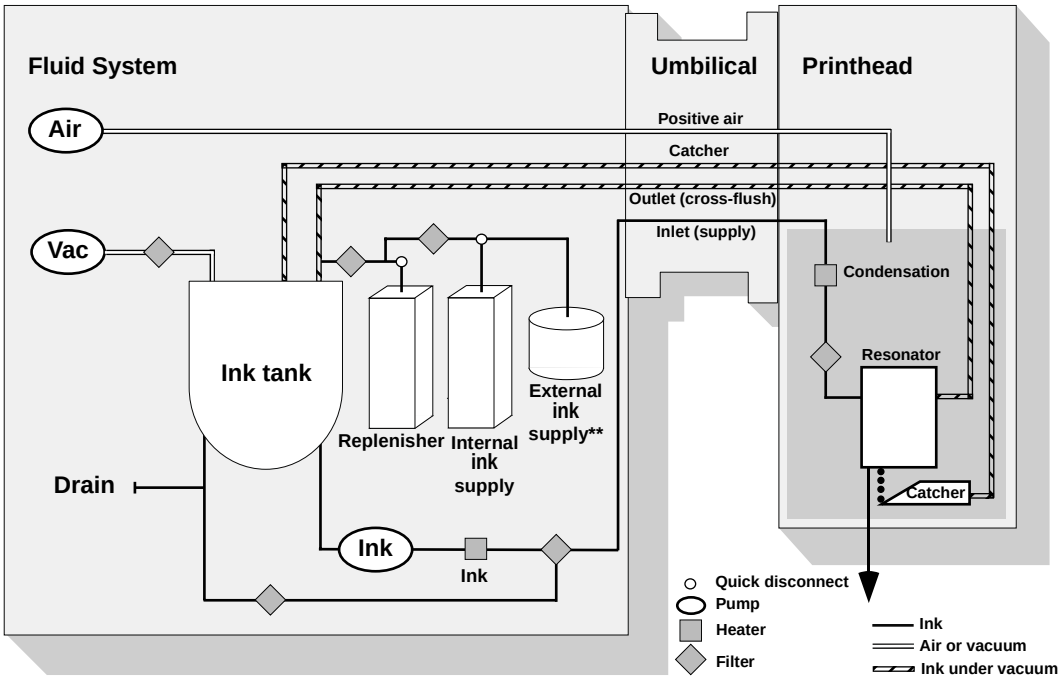
- Outlet (cross-flush)
- Catcher
- Positive air

The three umbilicals differ in that there is a condensation heater line in the 5240 and 5122 umbilicals, and the 5122 umbilical also has larger diameter fluid lines.

Fluid System

The fluid system delivers ink and replenisher to the printhead, removes ink from the printhead using vacuum, and fills the printhead housing with positive air. The inkjet controller board (IJC) runs this sub-system and operates all the components that regulate the flow of fluids through the printer, from the ink supply through the umbilical to the printhead (see Figure 1.2). The operation of the IJC is described in detail in Chapter 2.

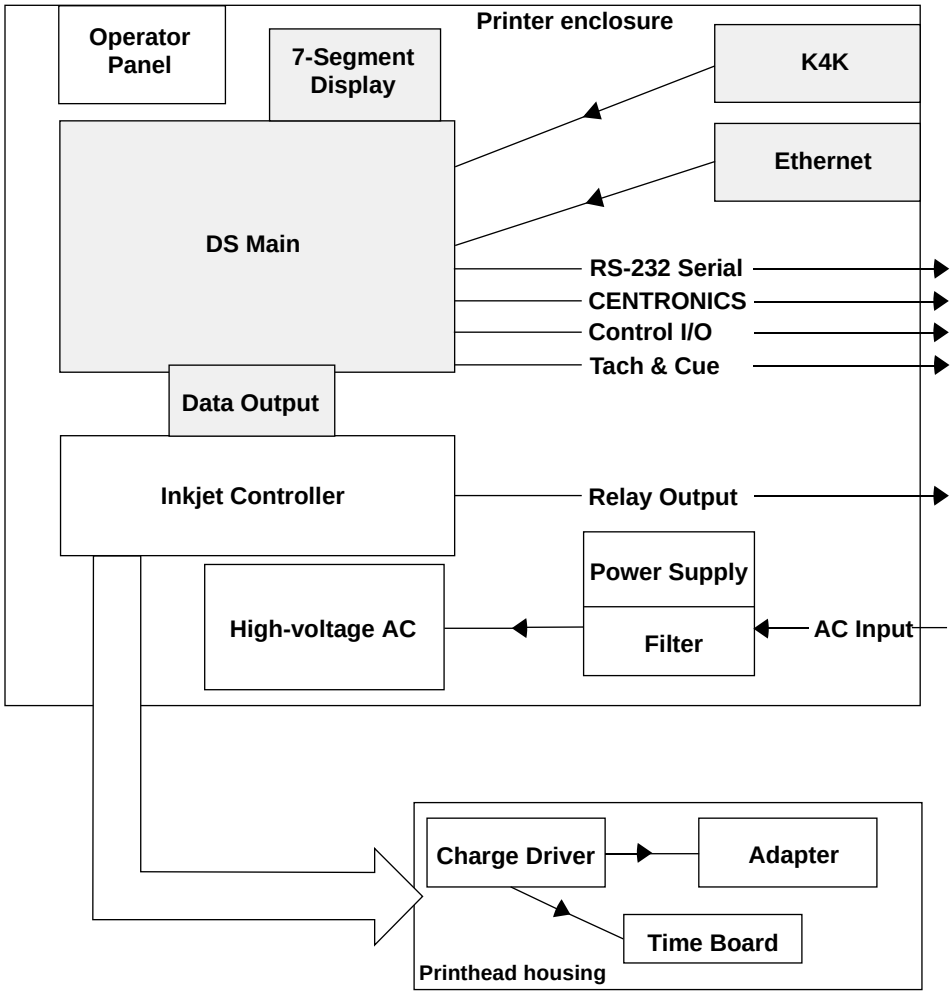
Figure 1.2 Fluid system operation, 5240 and 5122 printers



Data System

The data system consists of the circuit boards in the printer enclosure, internal and external cables, and related electronics in the printhead and umbilical (see Figure 1.3). The data system processes input data received from a controller or input device, converts that data into an image bit-map, and sends electrical signals to the printhead that control charging and form the inkjet image. The operation of the data system is described in detail in Chapter 2.

Figure 1.3 Data system components, 5240 and 5122 printers



Functionality and Reliability

The following sections relate printhead and fluid system reliability and functionality. The basic function of each sub-system relates directly to its potential as a source of printer or system problems. Use this information as an introduction to the troubleshooting procedures in the *Service Guide*.

General Guidelines

The following general guidelines apply to all 5000 Series printers:

- Routine maintenance is the single most important factor in printer reliability. Consistent, proper routine maintenance will result in very high printer reliability. Most common problems that cause printer down time are solved by cleaning the printhead or changing filters.
- The majority of printer problems not related to lack of routine maintenance are caused by job setup or data preparation errors. The fastest way to determine this is to print a test pattern. If the test pattern is okay, the printer is not the source of the problem.
- Printer and controller hardware failures are the least likely cause of a problem and when they occur, the source of the problem is generally easy to determine using Jetscape diagnostics (see the *Service Guide*).
- Reliability is enhanced by limiting startup and shutdown cycles. The more the printer runs, typically the better it performs. Idle periods longer than the average ink drying time increase the potential for problems because ink dries on the bottom of the printhead and even inside it. Thorough and consistent cleaning is especially critical for a printer that is used infrequently or intermittently.

Fluid System Guidelines

The following specific guidelines apply to all ink-related aspects of operation:

- Cleaning is the most effective means of preventing problems. Dirty printheads will streak, drip, and eventually develop shorts, commonly exhibited as crooked jets. Actual printhead hardware failures are rare, and the most common problem, etching of charge leads or the orifice plate caused by prolonged contact with charged ink, is drastically reduced or eliminated by rigorous routine maintenance. The only serious problem that cannot be prevented by cleaning is resonator failure due to the strain imposed by constant, high-frequency stimulation, and it typically affects only printheads with a very high number of hours.

- Check printed output for streakers and other defects diligently. Do not rely on error messages to call attention to a printhead problem. Frequent visual inspection will catch problems early when they are easily fixed and reduce down time.

- Monitor ink concentration and change ink to avoid high concentration that will shift the phase window up and reduce print quality. Always perform a printhead clean before adjusting phase or voltage.

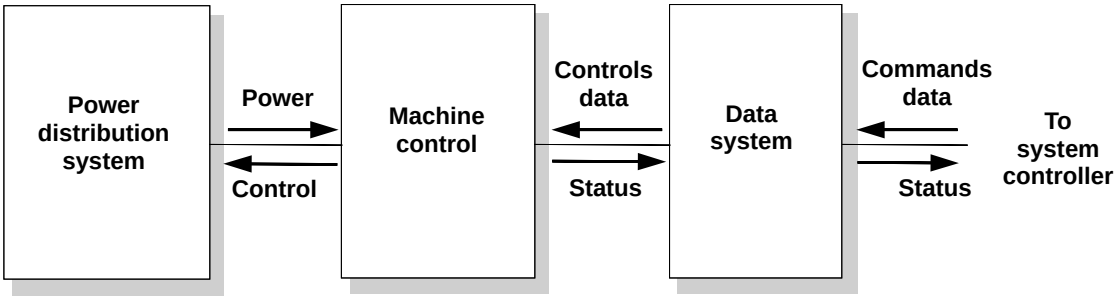
Chapter 2. Printer Functions

This guide divides the printer functions into the following four categories:

- Power distribution
- Machine control
- Data system (DS)
- Host (or system controller) communication

These four functional categories relate directly to the three major sub-systems of the printer (see Figure 2.1).

Figure 2.1 Major printer sub-systems



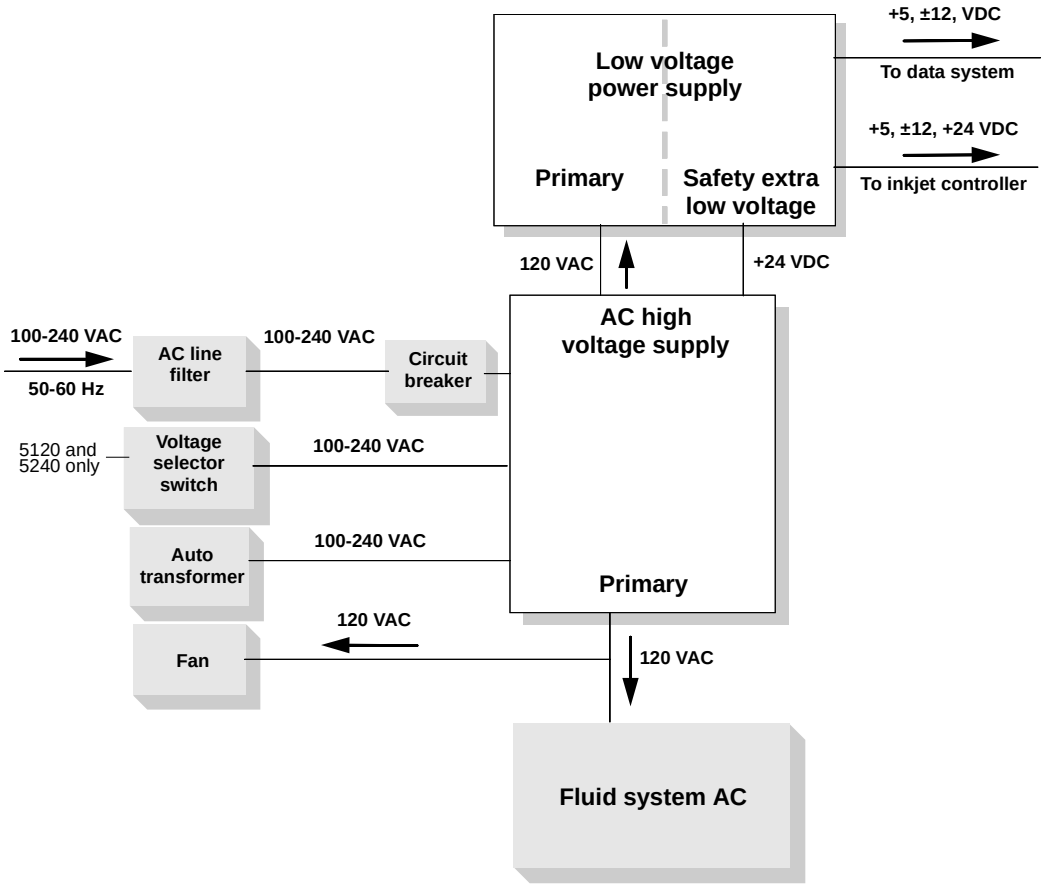
Power Distribution

The power distribution system performs the following functions:

- Provides filtered electrical power to all parts of the printer
- Converts the line voltage to the levels of alternating current and direct current needed by various parts of the printer
- Provides overload and short circuit protection
- Provides hardware for controlled shutdown of the printer

The basic components of the power distribution sub-system are shown in Figure 2.2. The circuit breaker switch on the rear of the printer allows external power to reach a transformer and the AC power relay. With the circuit breaker switch in the line on position, the printer can be turned on with one operator panel button. This button is a software-controlled, AC power relay. The ACHV low-voltage power supply supplies isolated +5V and +12V supplies for the secondary circuits, and an isolated supply to the catcher heater for sensing and control. The ACHV high-voltage DC power supply provides charge voltage for the printhead ranging from 5V to 180 VDC with a maximum current of 40mA. The 5122 lacks the voltage selector switch present on the 5120 and 5240.

Figure 2.2 Power distribution, printer



Data System

The data system consists of the following components:

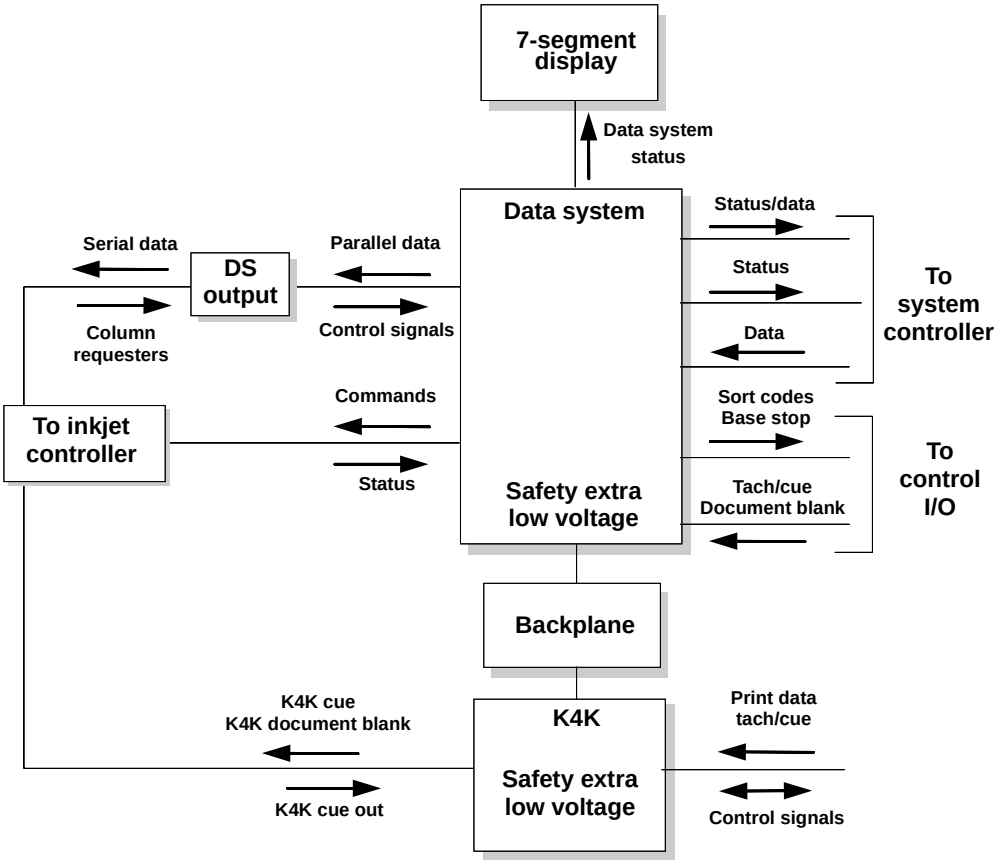
- Data system (DS) main board
- DS output board
- K4K board (optional)
- Seven segment display

The data system provides overall control of printer operation, including the following functions:

- Receives print data and commands from the system controller
- Formats print data
- Generates character bitmaps
- Transmits commands and formatted print data to the inkjet controller

As shown in Figure 2.3, the data system also provides two-way communication between the operator and printer using the software installed on the system controller.

Figure 2.3 Signal and data flow, data system



Machine Control

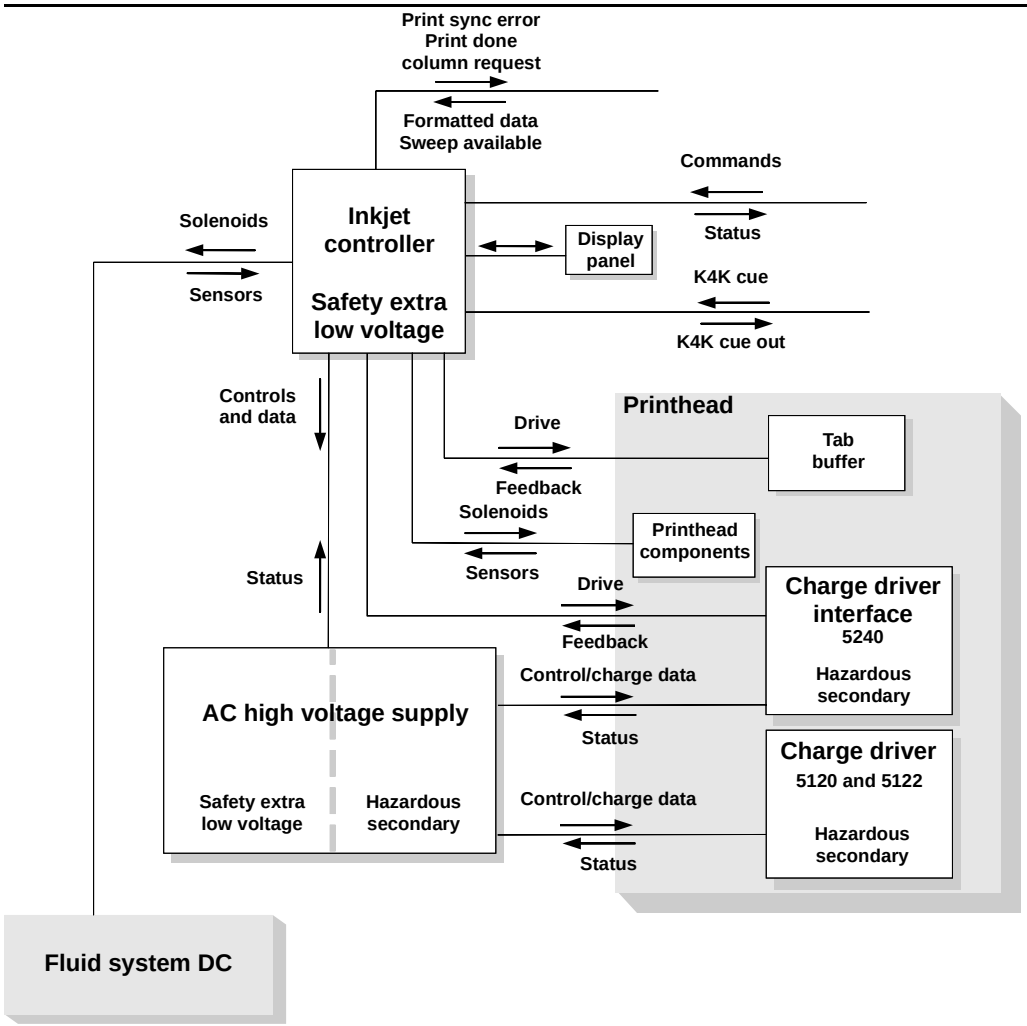
Machine control consists of the following components:

- Inkjet controller assembly
- Printhead
- Printer operator panel
- Fluid system

As shown in Figure 2.4, machine control performs the following functions:

- Receives and interprets commands from the data system
- Controls ink flow through the fluid system and printhead
- Performs dot generation and printing

Figure 2.4 Signal flow, machine control sub-system



Host Communication

This section describes data, commands, and status signal flow between the printer and the host controller in the basic printer operating states.

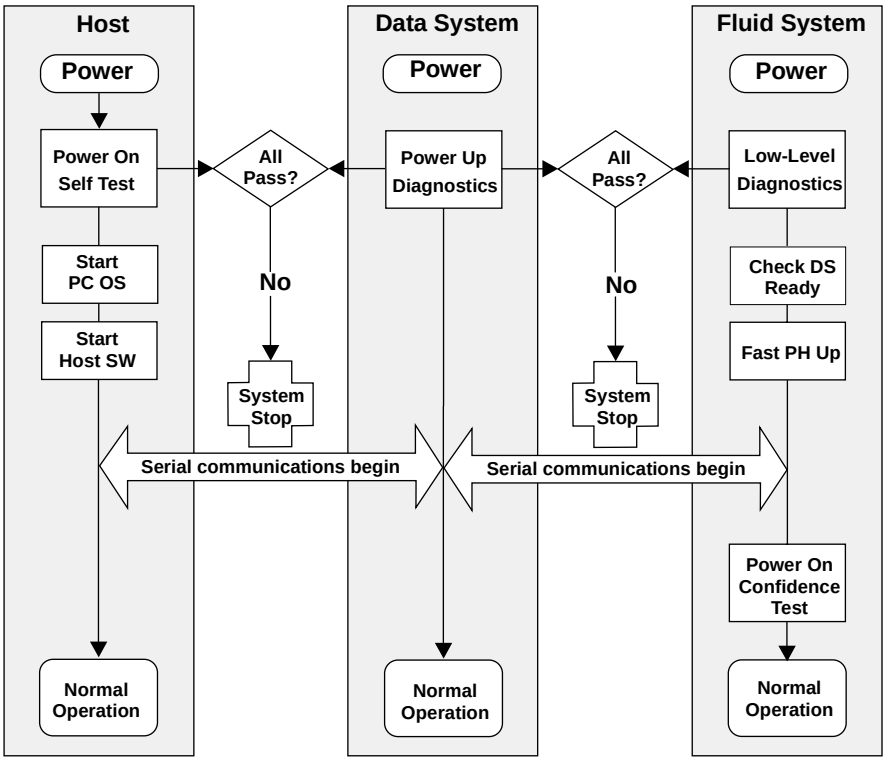
Startup

Startup describes the normal method of putting the printer in a ready-to-print state and is normally interchangeable with power-up.

Caution: To protect printer and printhead electronics, always follow the startup and shutdown procedures.

When powered up, the Data System (DS) main and IJC assemblies perform power-on confidence (POC) tests. Figure 2.5 shows the main steps in this startup sequence. When the POC is successfully completed, the DS main assembly sends a command to the IJC assembly to bring the fluid system and printhead into a ready, but offline state, in which the fluid system is on but the eyelid is closed (shown as “normal operation” in the diagram). Lights on the operator panel indicate the printer is on and in standby. The process completes even if an error is detected. A fluid system error (detected by the IJC) lights the error indicator on the operator panel. Except for error IJ-40, the printer will attempt to complete the startup sequence and reach ready three times when a fluid system error is detected. A data system error lights the three lower-left panel lights. These lights remain lit after the startup sequence terminates.

Figure 2.5 Startup communications sequence, printer and host



Printing

An open eyelid command puts the printer online, and allows the data system to accept commands from the system controller through the RS-232 interface. Commands are processed as received until an error is detected. Communication with the fluid system is over the RS-232 serial interface through the DS main board (J3) to the inkjet controller (J4).

Data is received by the data system main over the Centronics parallel or K4K parallel interface. The following critical signals control host and printer communication:

- Initialize (INPUT PRIME) clears the data system input buffers and any pending documents
- Select (SLCT) indicates to the host that the data system is ready to print
- Error (/FAULT) alerts the host to a printer problem that may stop or prevent printing.

The DS main assembly converts the data into bitmap images (print data) to be used for printing. The print data and formatting commands are then sent to the DS output board over the VME bus. The DS output board sends the data and commands to the IJC assembly.

The IJC assembly counts tachs and cues to track the position of documents and produces a print enable signal at the correct time. The DS output board holds formatted data until the IJC assembly determines that the document is in the correct position for printing; the IJC assembly then sends the data to the charge driver in the 5120 printhead or to the charge driver interface in a 5240 or 5122 printhead. The more advanced charge driver interface combines the charge driver and charge plate. Charging uses the formatted print data to control which leads deflect ink into the catcher. Undeflected drops form the image on the substrate.

During printing, the DS main monitors systems, reports errors, and sends the start print and end of print signals to the DS output board.

Shutdown

Normal shutdown starts when the printer on button is pressed with the printer turned on. The IJC assembly software receives the power down command and relays it to the DS main. Normal shutdown requires that the circuit breaker remain in the line on position.

If the printhead is ready when the shutdown starts, the IJC assembly evacuates fluid from the printhead to prevent ink residue from causing problems at the next startup. After evacuation, the IJC assembly waits three seconds, then turns off the AC power relay.

Caution: The AC line filter, circuit breaker, and AC power relay control circuit are still connected to the AC mains. Turning off the circuit breaker disconnects the AC power relay control circuit from the AC mains. The line filter and one side of the circuit breaker are connected to the AC mains as long as the power cord is attached.

Chapter 3. Controller Functions

A controller combines with one or more printers to create a printing system. The terms controller, host controller, and system controller are interchangeable with regard to printer functions. This general description of controller functions is divided into the following sections:

- System overview
- Controller functions

System Overview

A printing system consists of the following major components:

- Printer (5120/5240/5122)
- Controller (PC with custom software)
- Options (tape drive, multiple printer interface, K4K, Ethernet)

The following characteristics define how the printer is used in a printing system:

- System configuration
- Software
- Interfaces

System Configuration

Communication between the printer and host data source provides the image data for printing and control signals needed for proper printer and host interaction. The 5000 series printers can operate in the following types of configurations:

- Printing system
  This is a stand-alone system with a controller dedicated to the 5000 series printer. With the multiple printer interface option, a dedicated controller can send data to three printers.
- K4K controller
  This is a system with a specialized controller, such as Scitex 4000 Series binding line controller, that sends data to printers, but also controls other devices, often through a programmable logic controller

(PLC). The number of printers is limited only by the capability of the controller; the practical limit for most applications is eight printers.

- System controller
  This is a network system built around a system controller such as a Scitex System Controller 220. The controller sends data to multiple printers and can have limited control over other devices. The practical limit for most applications is 8 printers, but a 12-printer or even 16-printer system is possible.

Note: This section describes only the printer-related aspects of controller operation.

The following sections describe printer operation in a system configuration. All systems require the following three basic elements:

- Software
- Interfaces
- Printer types

Software

Controller software controls system operation, but must be compatible with the printer software. Printer software comprises the following components:

- Data system main board firmware and flash memory
- Inkjet controller firmware

Printer and controller software versions, compatibility between different components, and flash memory options are described in the *Service Guide*.

Controller software defines both the printing system and the type of controller. Table 3.1 shows the various types of standard system configurations.

Table 3.1 System configurations, 5000 Series printers

	Printer Used / System Type		
Host Software	**5120**	**5240**	**5122**
Jetscape	5120 Printing System with Jetscape	5240 Printing System with Jetscape	5122 Printing System[1]
MailScape	5120 Printing System with MailScape	5240 Printing System with MailScape	
Custom	Not named[2]		
MPC3 or MPC4	Scitex 6240 Printing System[3]		
Binding Line	Scitex 4000 Series Binding Line Controller System		

1. The standard software includes both controller programs. MailScape only is also available, but only Jetscape is not supported.
2. Custom software and controller hardware is not described. The basic functions of most custom software applications are similar to Jetscape.
3. This is any system that includes a Scitex 100 System Controller, 200 system controller, or system controller 220.

All configurations cannot be listed, as custom configurations can combine elements of more than one system, and such hybrid configurations cannot be described in general terms.

Jetscape This controller software application comprises the following four programs:

- Print Control
- Control Panel
- Diagnostics
- Layout

The first three programs are MS-DOS® operating system programs. Print Control allows the operator to create, edit, save, and print job setups. Control Panel allows the operator to perform printer functions from the controller screen instead of the printer operator panel. Jetscape Diagnostics monitors both printer and controller operation and provides tests for determining the source of a printer or controller error. Tests can be selectively run on all the major components of the printer. Diagnostics supplements the power-on sequence tests that run automatically when the printer is turned on. Figure 2.5 shows the communications that occur during the start-up sequence. For a complete description of Jetscape diagnostics, see the *Service Guide*.

Jetscape Layout is a Microsoft Windows® 3.1 operating system program with a GUI for creating, editing, and saving job setups for the 5120 and 5240.

Jetscape is installed on a PC connected to the printer through its serial and parallel interfaces. To function correctly, Jetscape must be configured to operate with the printer connected to the host, and the job must be properly set up.

MailScape This printer control program provides the same basic functions as Jetscape Print Control, but in the Microsoft Windows® 98 operating system environment. Jetscape Control Panel is still required with MailScape to operate a 5000 series printer from the controller screen.

To function correctly, MailScape must be configured to operate with the printer connected to the host, and the output module must be properly configured. MailScape has built-in diagnostics that can be used to test an output module created for a 5120 or 5240 printer. For the 5122 printer, Jetscape Diagnostics must be used.

Service Considerations From a service perspective, the basic guideline for understanding potential controller problems is to recognize that configuration and job setup errors are often mistaken for printer problems. Printing a test pattern is the easiest way to differentiate a host problem from a printer problem. If the test pattern is okay, the problem is not in the printer. If the problem is in the controller, first check the system configuration, then the job setup, and finally run diagnostics on the controller itself.

For detailed descriptions of controller software, see the Jetscape Control Panel *Operator's Guide* (0114083), Jetscape Print Control (0113817) *Operator's Guide* (0113817), and the MailScape *Operator's Guide* (0114081).

Interfaces

The critical link in a printing system is a set of interfaces between the controller and all connected printers. The following basic interfaces are required for any system:

- Data
- Tach and cue
- System control

The data interface provides the image data for printing. Tach and cue time the movement of the substrate and start printing in coordination with substrate movement. System control provides, at minimum, a means of starting and stopping the movement of the substrate.

Seven different connectors on the printer carry the three basic interfaces required for operation. Five of these connectors are multi-functional. Table 3.2 lists the functions of each interface.

Table 3.2 Interface functions, 5000 Series printers

Interface	Functions	To	From
Centronics	Data / system control / tach and cue	-	Host
RS-232 serial	System control / data / tach and cue		
K4K	Data / system control / cue for document count		
Control I/O	System control / differential tach and cue	I/O box / Host	
Tach and cue	Tach and cue	-	Source Devices
Relay output	System control	Controlled Device	-
Ethernet	Data / system control	-	Host

The next section describes interface functions. For a detailed description of all interfaces and signals, see the *Service Guide*.

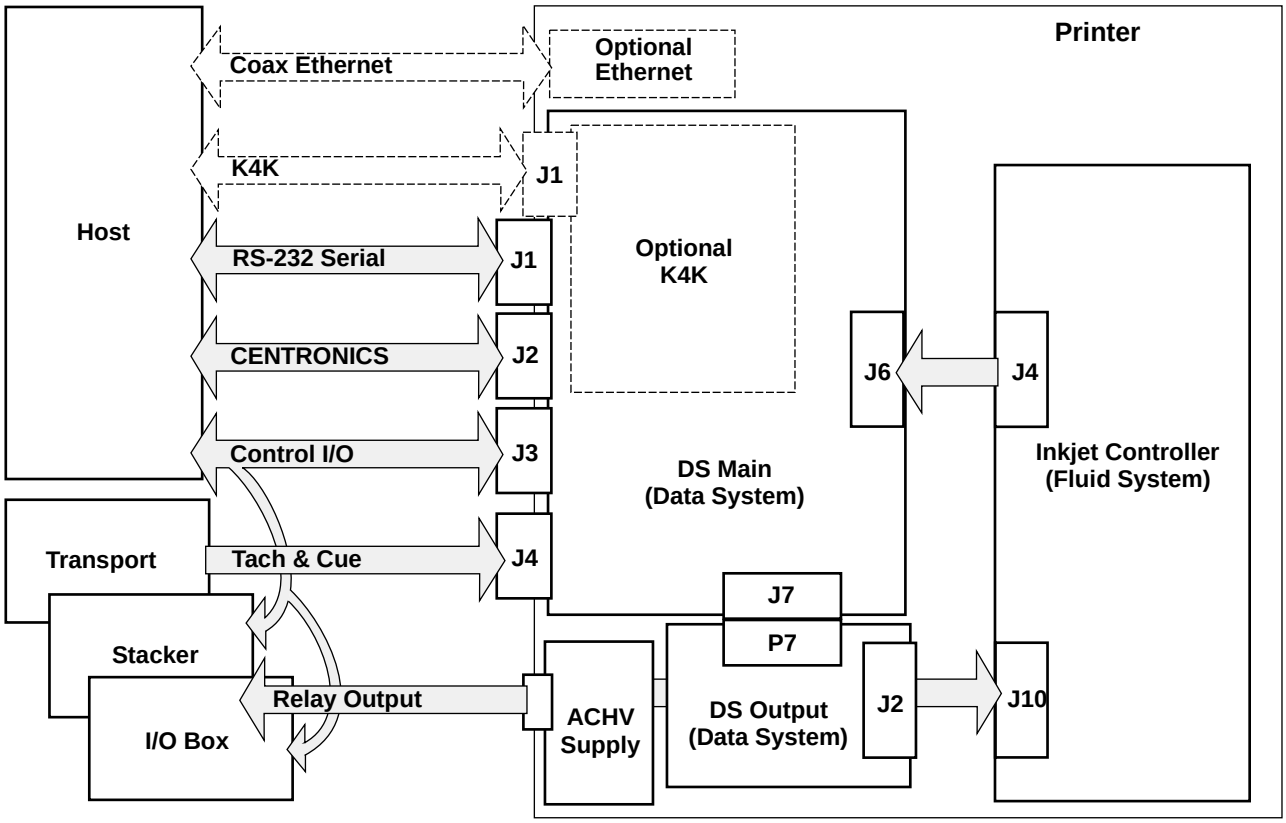
Controller Operation

The controller converts input data base records into documents in Native Input Command (NIC) or Inkjet Printer Data Stream (IJPDS) format, and if fonts are not loaded in memory at the printer, the controller downloads them to the printer along with the image data (documents). These basic functions can be broken down into the following operations:

- Data source
- Tach and cue
- Print control
- Layout

These basic operations relate directly to the seven interface connections on the printer. Figure 3.1 diagrams the basic interconnections between printer, host, and other system components.

Figure 3.1 Communications paths, system configuration



Data Source

The controller retrieves image data from its hard disk, the optional tape drive, or a network server and sends it to the printer over one of the following interfaces:

Centronics The datapath Centronics parallel interface is the most commonly used data connection. This 36-pin connector carries eight data lines (DATA 1-8) and the following control signals:

- $\overline{\text{STROBE}}$ is active when DATA 1-8 are valid.
- $\overline{\text{ACK}}$ goes active when a byte of data has been received.
- BUSY goes active after $\overline{\text{STROBE}}$ goes inactive (indicating a byte received) and the FIFO goes full (4096 bytes loaded) to signal the host that the printer is unable to receive data. BUSY goes inactive when the FIFO reaches half full (2048 bytes loaded). BUSY also goes active if the printer goes offline and remains active until the printer is put back online.
- SELECT goes active (high) when the printer is online and ready to receive data. It goes inactive (low) when the printer is taken offline.
- $\overline{\text{INPUT PRIME}}$ goes active when the host clears the data system buffers including any pending documents.
- $\overline{\text{FAULT}}$ goes active when a printer error condition exists.

RS-232 Serial The serial interface is primarily the communications path between the host, data system, and fluid system, but it can be used as a data connection. The printer serial port is a standard EIA RS-232-C interface with an additional printer ready line (PR) and ground used to configure data terminal equipment (DTE). The serial interface can be the data input for the printer, but with a host controller, it is used for status information, with data input over the parallel interface. When connected to a controller, the port requires a null-modem cable. When it connects the printer to a modem, it requires a straight-through cable. In addition to eight data lines, the serial interface provides nine status signals and three grounds.

K4K The optional, 50-pin K4K interface is a custom, parallel connection that provides differential, simultaneous transmission of status and image data with checksums to ensure data integrity. The K4K design was was ported over from the Admark printer to allow 5000 series printers to replace Admarks operating with binding line controllers (and in other applications using data transmission in Admark mode). With the 5120 and 5240, the K4K can use the Admark input format, but now the K4K is typically used the same as the Centronics parallel port to receive standard NIC-format data.

To use K4K, the printer must have compatible software, optional hardware installed, and have the proper switches set on the DS main board. The optional hardware is the K4K board, cables, and back panel connector.

In addition to 8 data bits, the K4K transmits 15 control signals and cue (input and output). Unlike the parallel interface, the K4K is capable of two-way simultaneous communication.

Ethernet The optional Ethernet interface provides a coaxial (Thinet, IOBase5) BNC connection for TCP/IP communication with a host, typically through a hub.

To use Ethernet, the printer must have compatible software, optional hardware installed, and have the proper switches set on the DS main board. The optional hardware is the Ethernet transceiver and cable.

Tach and Cue

The printer must receive tach and cue to print, but the signal source varies depending on the system configuration. The printer can also output tach and cue to other devices.

Tach and Cue Input tach and cue for the printer is carried over this dedicated 9-pin connection. If the printer is operating standalone, this connection goes directly to the tach encoder and cue sensor. If the printer is part of a system, this connection goes to the controller which provides processed tachs and cues.

Control I/O Differential tach and cue inputs can be received through this connector.

K4K Cue is carried on this interface to provide a document count for specialized applications.

Print Control

Controller software provides a means of creating a job setup, or modifying an existing setup. The job setup determines how the image data appears on the printed document. When job setup information is included in the data file, it is transmitted and processed along with the image data for the job. Once the setup is processed, only the information needed by each printer is transmitted along with the image data for printing. When this automatic setup function is not used, the operator must select a existing setup and use it to print the job, select and modify an existing setup, or create a new setup.

All setups define how the image data is arranged on the document. Each part of the image data is assigned to a field, or position, on the document, given an orientation, and assigned other parameters such as fonts for text.

Setup errors account for many problems mistaken for printer malfunctions. Incorrect setup can result in no visible image being printed, partially printed images, truncated images, or otherwise improperly formatted data. The simplest method of checking image data is to print a test pattern. If the test image is okay, the printer is functioning correctly, and the setup should be checked. If the setup is okay, the image data should be previewed to check the data file.

Layout

Jetscape includes a document layout utility that allows the operator to set up jobs using a WYSIWYG graphical user interface (GUI) common to all programs that run under the Microsoft Windows® operating system. Layout cannot be used with the 5122 printer.

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