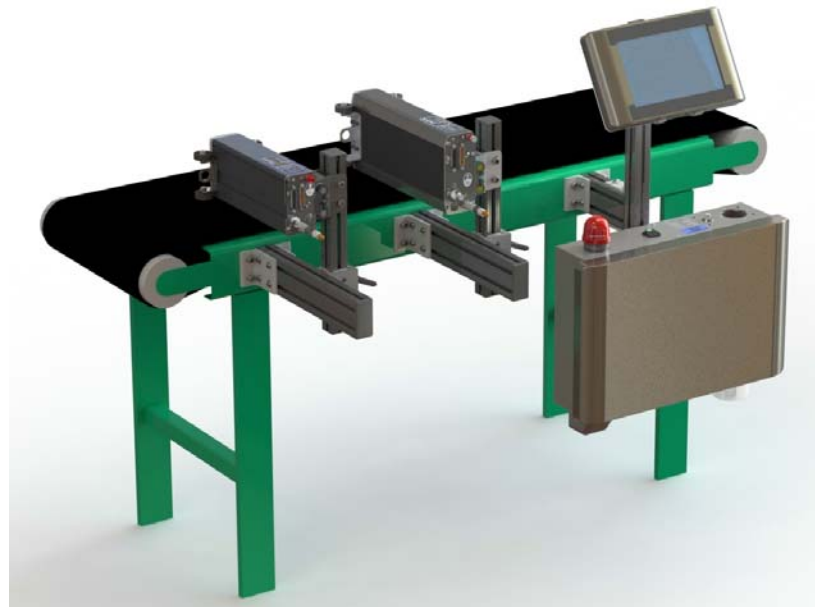# Operations Manual

IJ4000 Impulse Jet System

5765-018
Revision J

IJ4000 Impulse Jet
Ink Jet System
Operations Manual

5765-018

IJ4000 System

Warranty:

The IJ4000 Impulse Jet System, including all components unless otherwise specified, carries a limited warranty.

The inks and conditioners used with the IJ4000 Impulse Jet System carry a limited warranty.

For all warranty terms and conditions, contact Diagraph an ITW Company for a complete copy of the Limited Warranty Statement.

Section 1: Safety and Ink Usage

Following is a list of safety symbols and their meanings, which are found throughout this manual. Pay attention to these symbols where they appear in the manual.

Wear safety goggles when performing the procedure described!

Caution or Warning! Denotes possible personal injury and/or damage to the equipment.

Caution or Warning! Denotes possible personal injury and/or equipment damage due to electrical hazard.

NOTE: (Will be followed by a brief comment or explanation.)

CAUTION: The SMART-IDS (Ink Delivery System) contains hazardous voltage (115/230VAC). Disconnect from mains power before:
• Performing preventive maintenance.
• Performing any repairs to the unit.
• Servicing the equipment in any manner.

ESD protection should be worn when servicing internal printed circuit boards.

After service to the equipment is completed, replace all protective devices such as grounding cables and covers before operating the equipment.
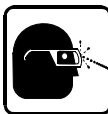
It is extremely important to:
• Clean up all spills with the appropriate conditioner immediately and dispose of all waste according to local and state regulations.
• Wear safety glasses and protective clothing, including gloves, when handling all inks and conditioners.
• Store inks and conditioners under the recommended conditions found on the SDS (Safety Data Sheet).

Service is to be performed by trained or ITW personnel only.

Section 2: Quick Start

The figure at right illustrates a typical installation with a controller and a print head. (Cables and ink lines are not shown.)

System Components:
- Bracketry Kit (Item 1)
- Print Head (Item 2)
- SMART-IDS (Item 3)
- IJ4000-HMI Controller (Item 4)
- Power Cord (not shown)
- Serial Cable (not shown)
- Tubing (not shown)
- Software (not shown)

(Ink is not included.)

NOTE: See limitations in "Tubing Limitations - Vertical" on page 13.

TYPICAL INSTALLATION
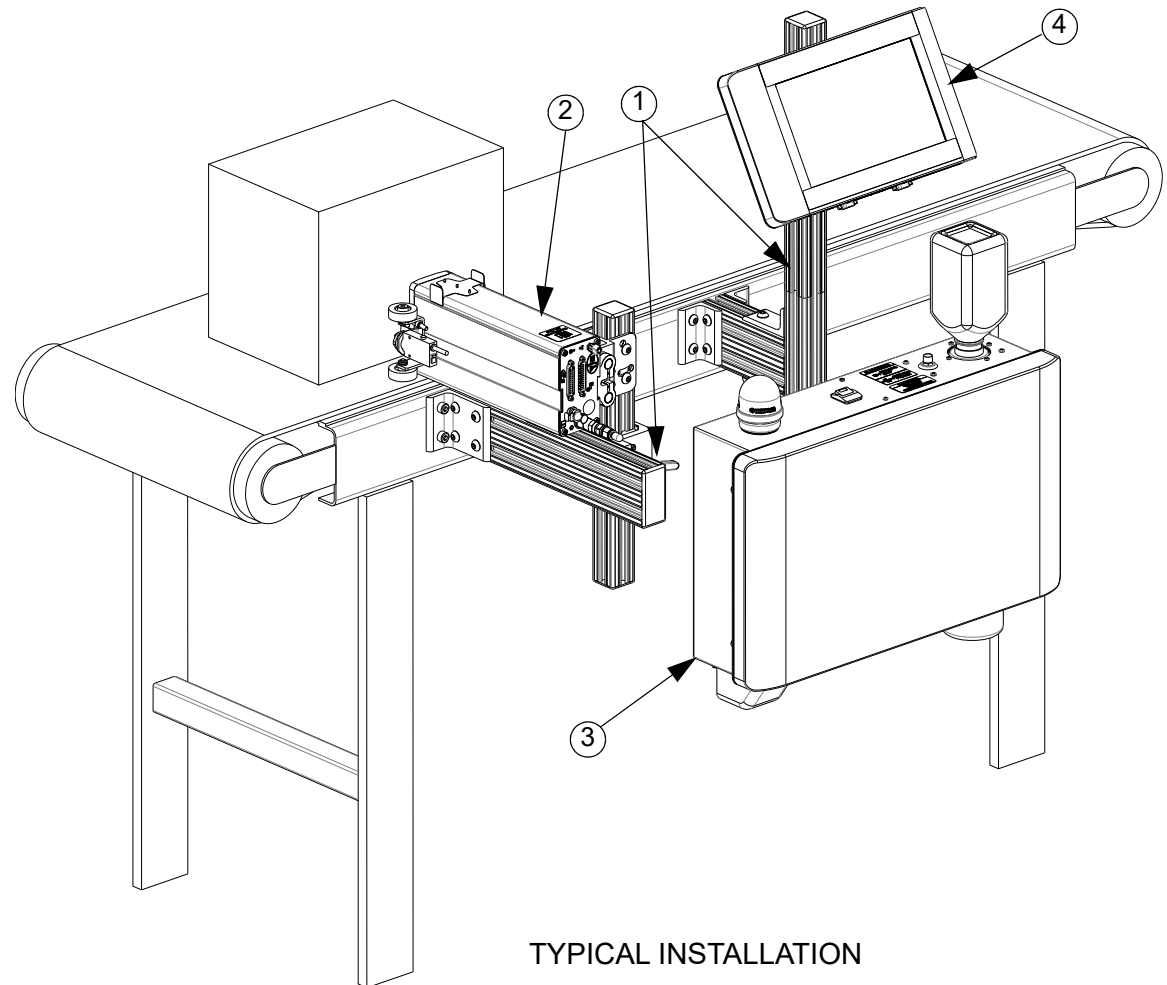
Step 1: Assemble Bracketry to Conveyor

NOTE: Mount bracketry as square and as level as possible.

PRINT HEAD
CONVEYOR MOUNT
(5765-246 for 384E Print Head)
(5765-253 for 768E Print Head)

HMI CONTROLLER /
SMART-IDS MOUNT
(5765-250)

OPTIONAL T-STAND
(5765-249)
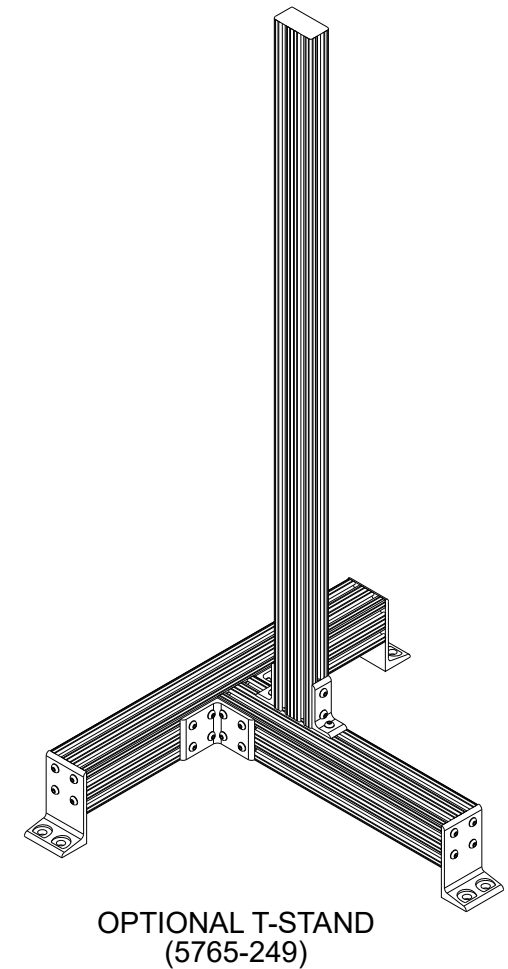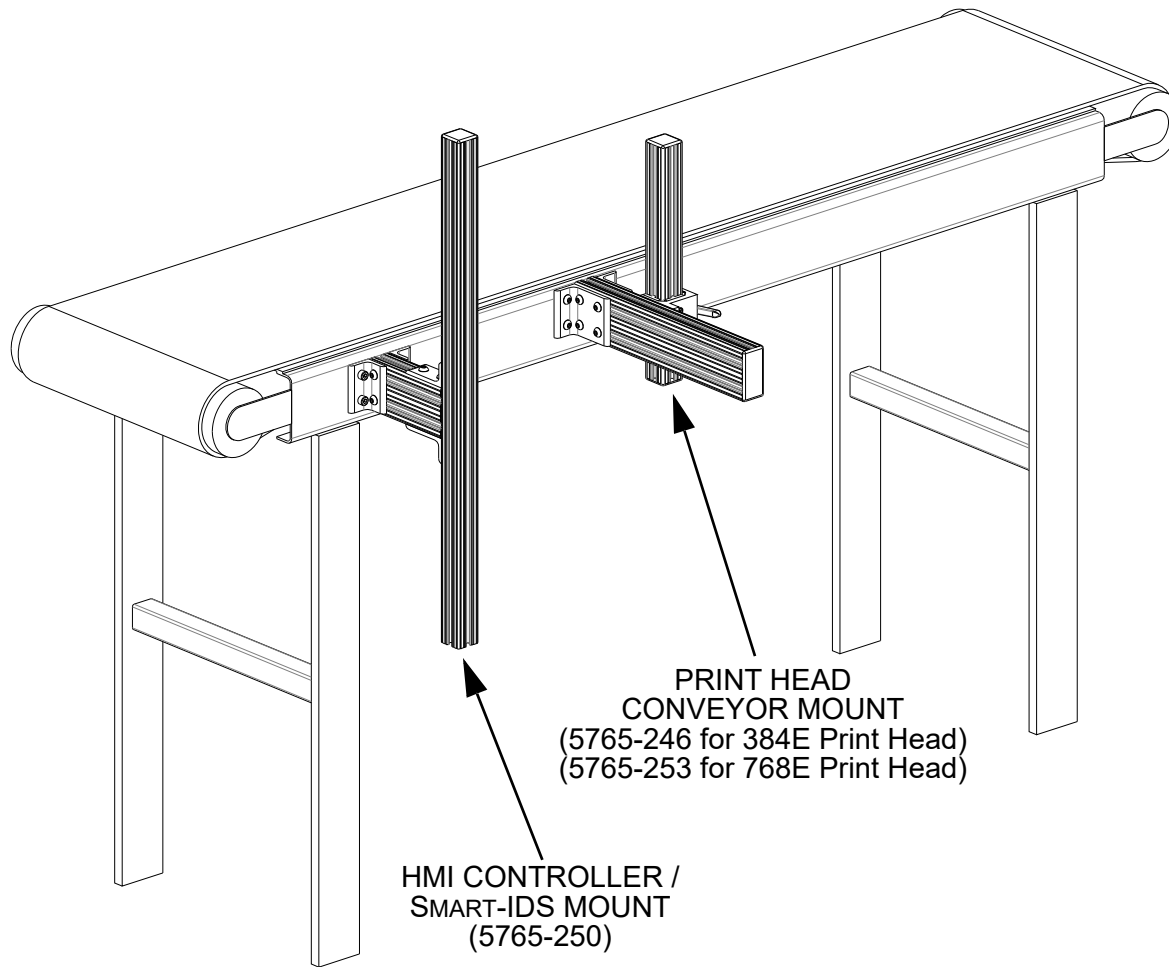
Step 2: Assemble Print Head onto Bracketry

RETRACTING
BRACKET CAN BE
MOUNTED ON EITHER
SIDE OF PRINT HEAD

ROLLER / RETRACTING
BRACKET MOUNT FOR
384E PRINT HEAD
(5765-246)

SINGLE-POLE FLOOR
MOUNT
(5760-355)

ROLLER / RETRACTING
BRACKET MOUNT FOR
768E PRINT HEAD
(5765-253)
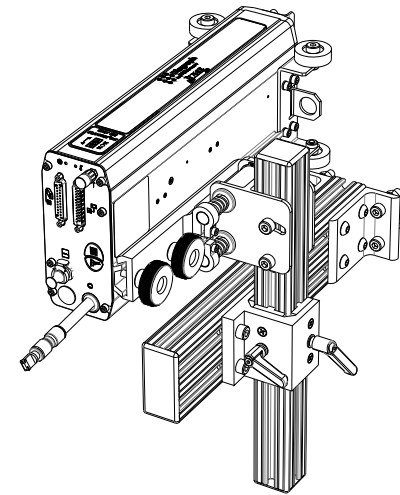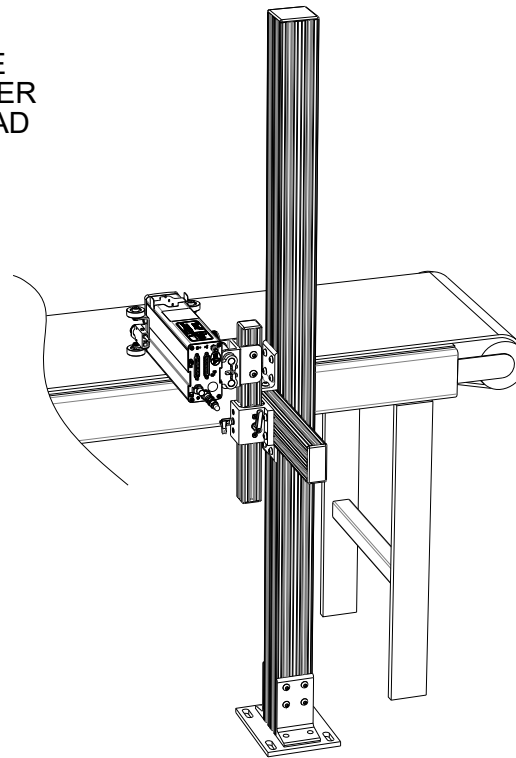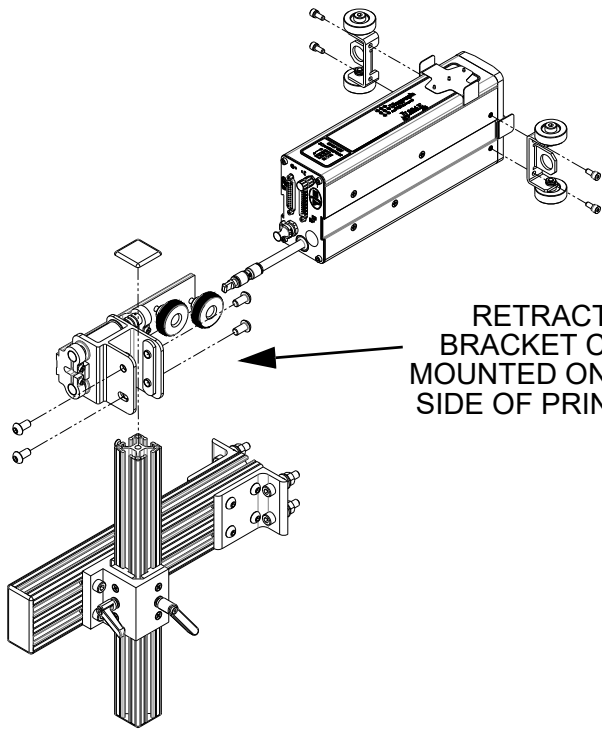
Print Head Mounting Limitations

Print Head Tilt

Maximum Print Head Tilt:
- Clockwise Tilt: 5°
- Counterclockwise Tilt: 5°

NOTE: Tilt angles are given when looking at the rear of the print head. Front to rear tilt should be less than ± 1.5°, as indicated by the digital level LED readout on the top rear of the print head.

± 5° MAX

768E PRINT HEAD

AB
CD

101,6mm [4in] SOLID CHARACTER HEIGHT

27,2mm [1.07in] TO LOWEST ORIFICE

± 5° MAX

384E PRINT HEAD

ABC

50,8mm [2in] SOLID CHARACTER HEIGHT

22,9mm [0.90in] TO LOWEST ORIFICE
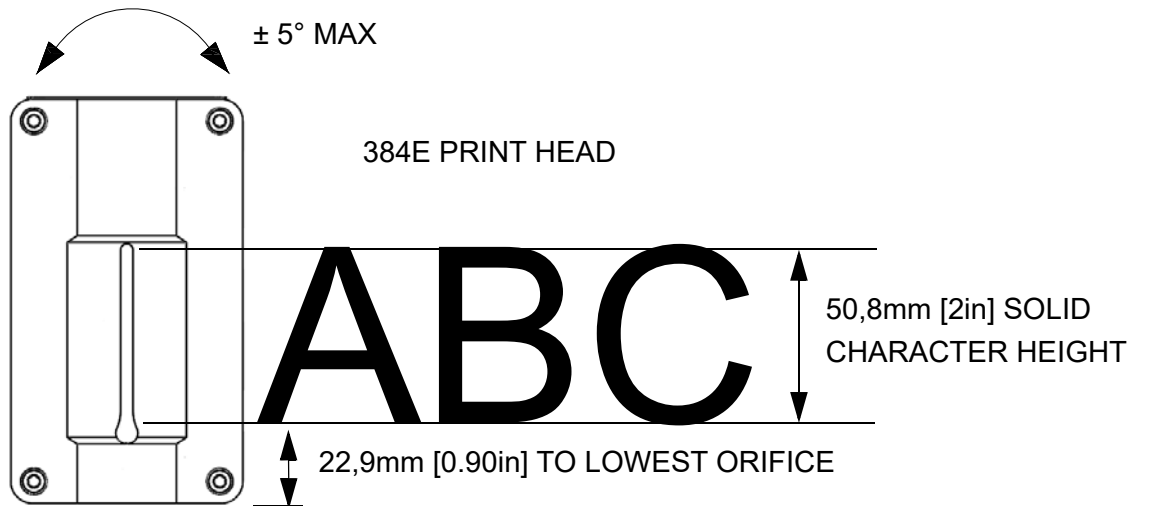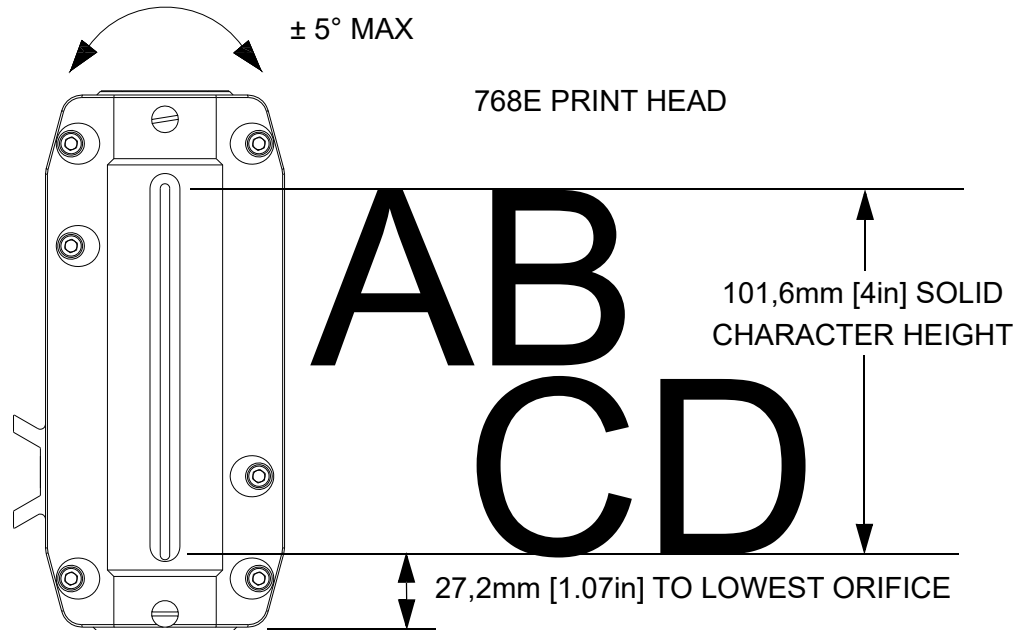
Step 3: Adjust Print Head to Substrate

Use the bracket handle to adjust print head vertically.

VERTICAL
ADJUSTMENT

BRACKET HANDLE
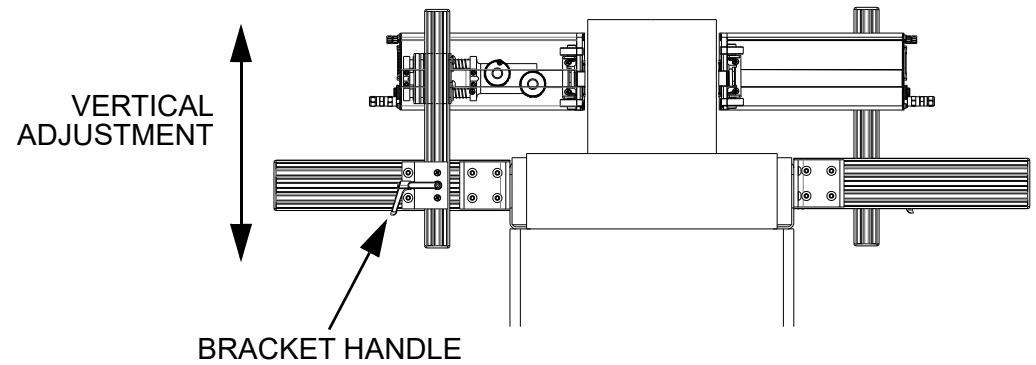
Loosen the adjustment knobs on the Retracting Bracket to slide the print head toward or away from substrate.

ADJUSTMENT
KNOBS

HORIZONTAL
ADJUSTMENT

3mm [.1in] GAP
RECOMMENDED

Step 4: Install SMART-IDS

OPTIONAL FLOOR
MOUNT
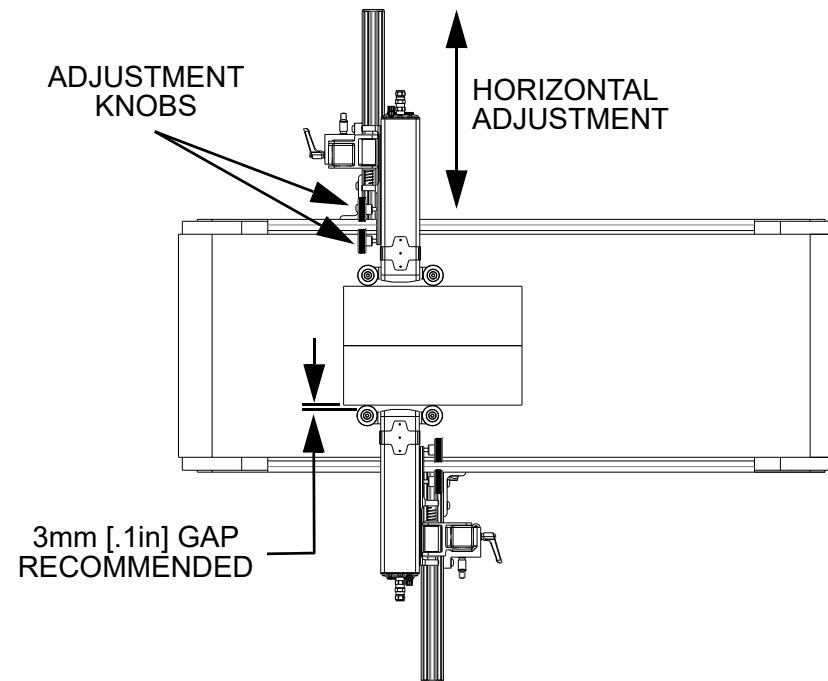
SMART-IDS

Tubing Limitations - Vertical

Best Practices

HMI
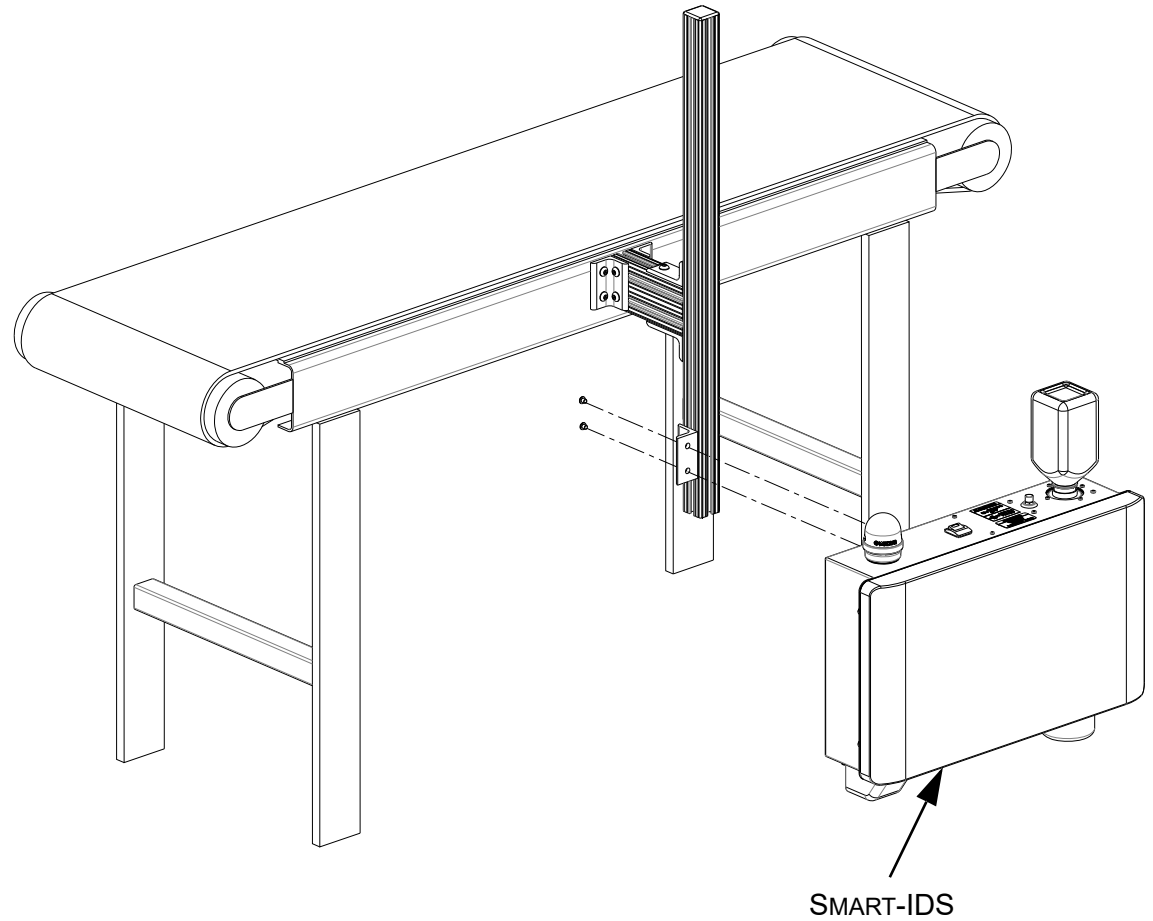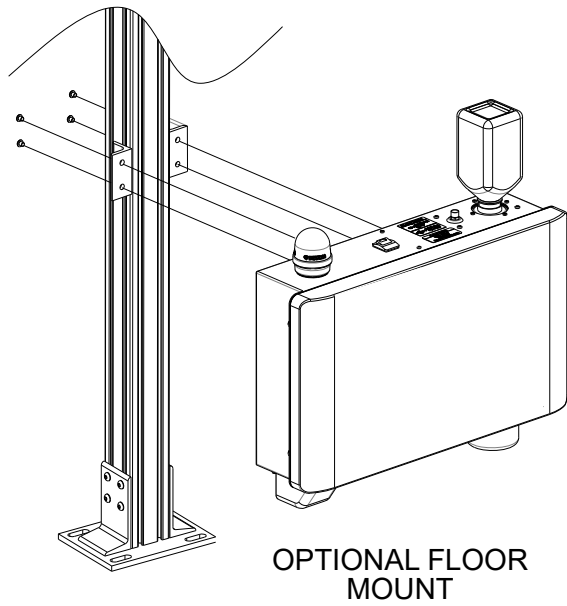
- Mount Smart-IDS below the height of the print heads.
- Do not create service loops or coils of tubing.
- Minimize length of tubing by cutting to length.

Conveyor

1.5m (5ft)
(Consult Factory if longer)

SMART-IDS
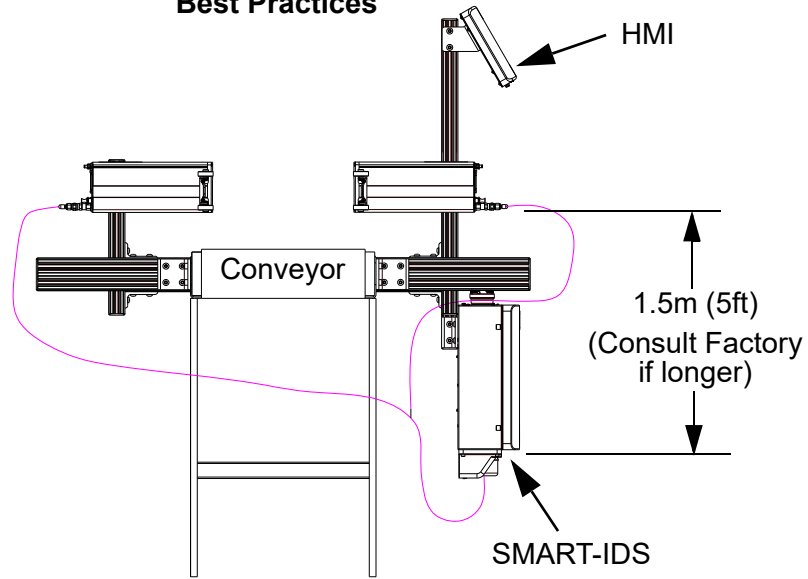
Alternate Configurations

HMI

HMI

SMART-IDS

1m (3ft)

Conveyor

SMART-IDS

1m (3ft)

Conveyor
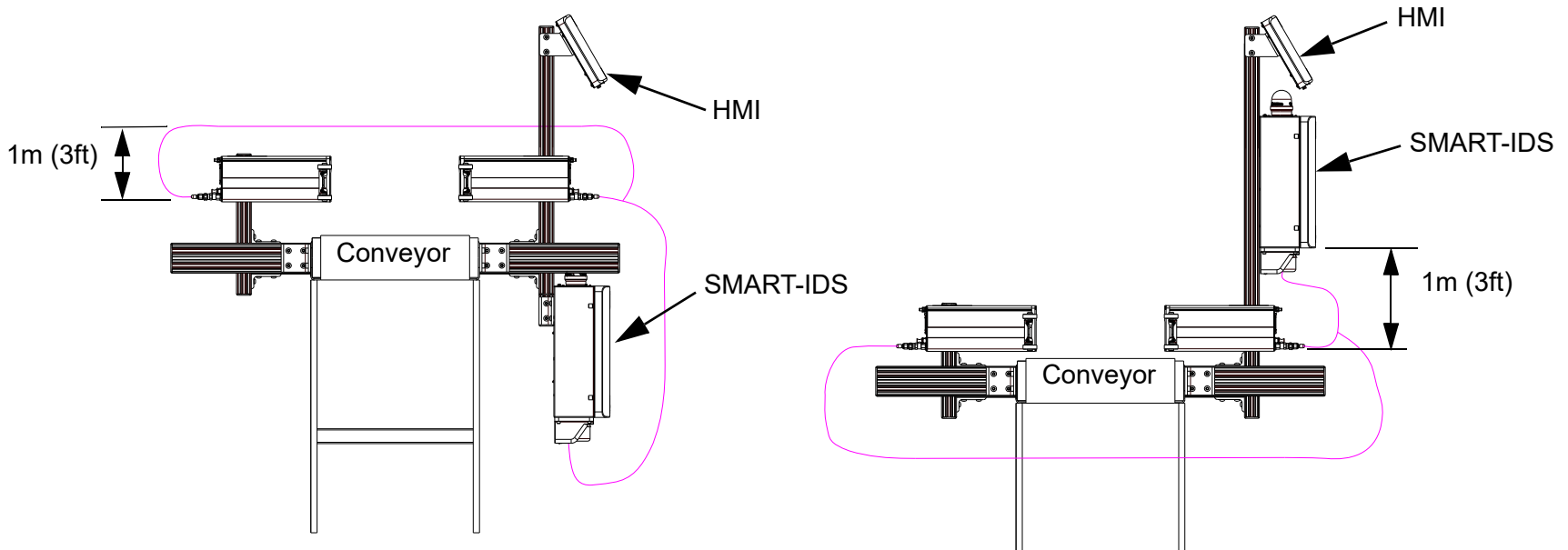
Tubing Limitations - Horizontal

768E Print Heads:

1 Print Head

SMART-IDS

12,2m (40ft)
Maximum Total Tubing Length

2 Print Heads

SMART-IDS

6,1m (20ft)
Maximum Total Tubing Length

384E Print Heads:

1 Print Head

SMART-IDS

15,2m (50ft)
Maximum Total
Tubing Length

2 Print Heads

SMART-IDS

9,1m (30ft)
Maximum Total
Tubing Length

3 or 4 Print Heads

SMART-IDS

4,6m (15ft)
Maximum Total
Tubing Length
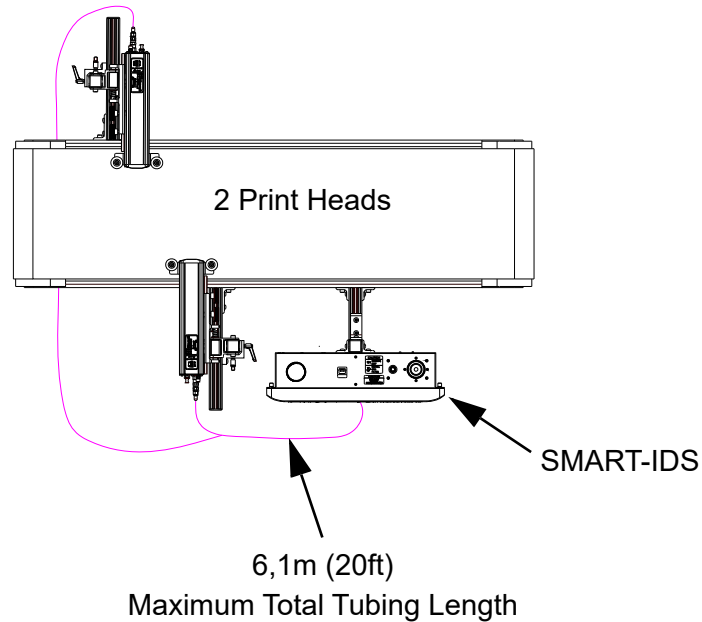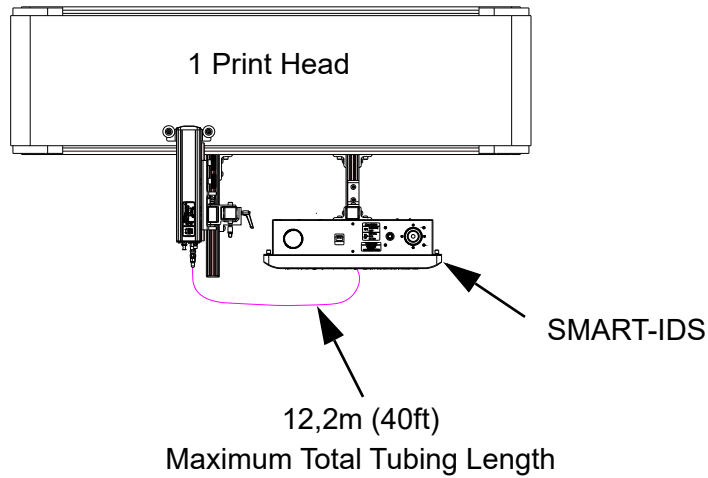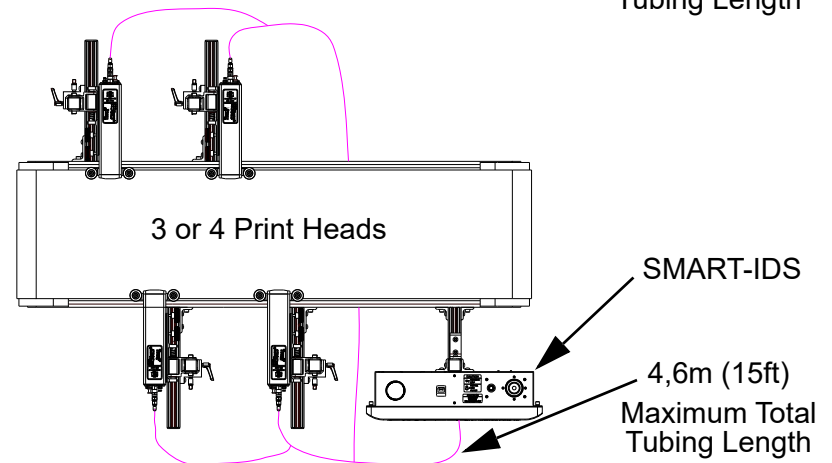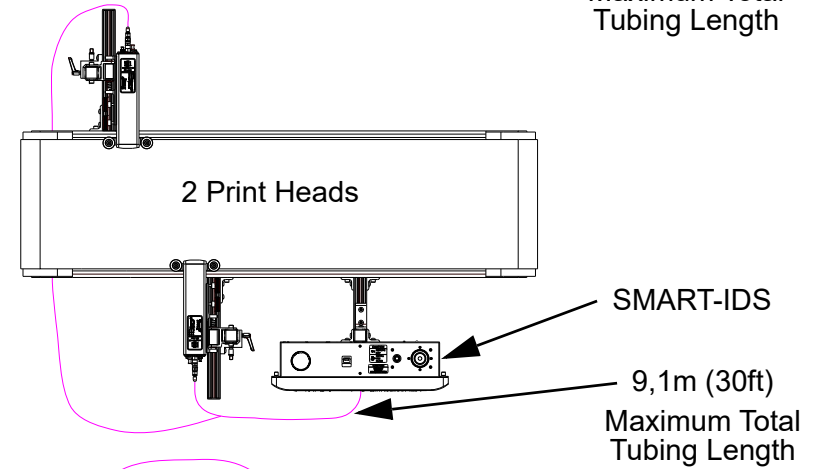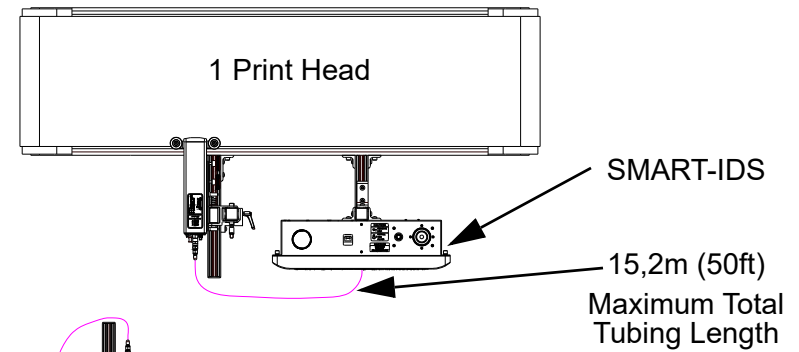
Step 5: Install IJ4000-HMI Controller
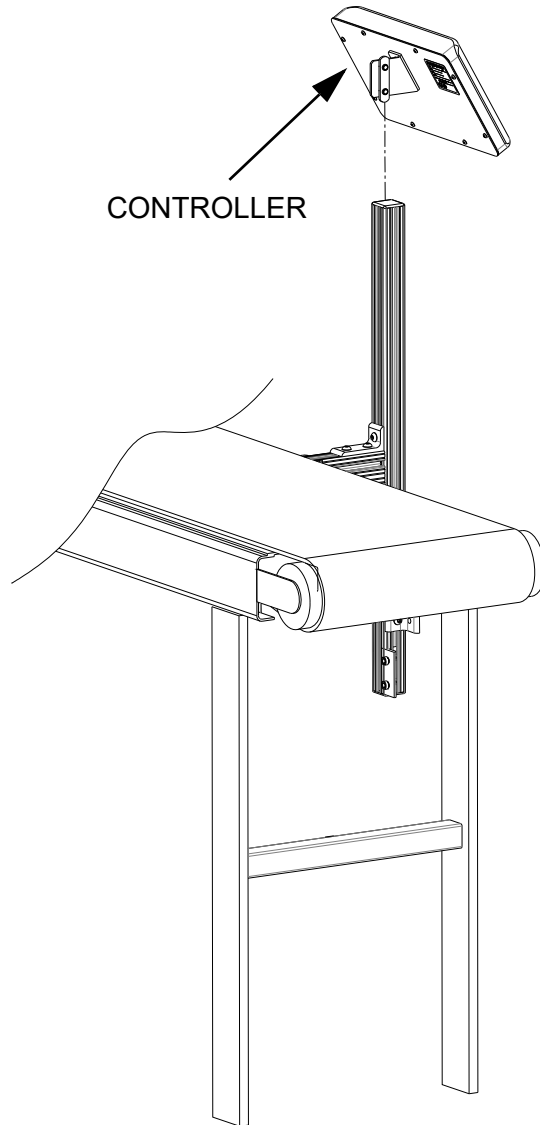
CONTROLLER

Step 6: Electrical Cable Connections

All controller cables must be routed through the Strain Relief Cable Clamp in the bottom of the SMART-IDS.

1. Refer to the adjacent diagram for typical electrical cable routing.

2. Connect all cables to their appropriate sockets. (Refer to the following page for SMART-IDS internal connectivity.)

3. Route and connect cables to the conveyor components (print heads, encoder, photocell).

4. Customer system connections are made inside the SMART-IDS. (Refer to the following page.)

NOTE: It is recommended that the Task 1 Print Head be closest to the IJ4000-HMI.

5. Plug the SMART-IDS into the appropriate mains power outlet.

NOTE: Ensure that the Smart-IDS is powered off. It will be activated as part of the ink line bleeding procedure.

NOTE: Connect IDS directly to upstream print head.

SMART-IDS
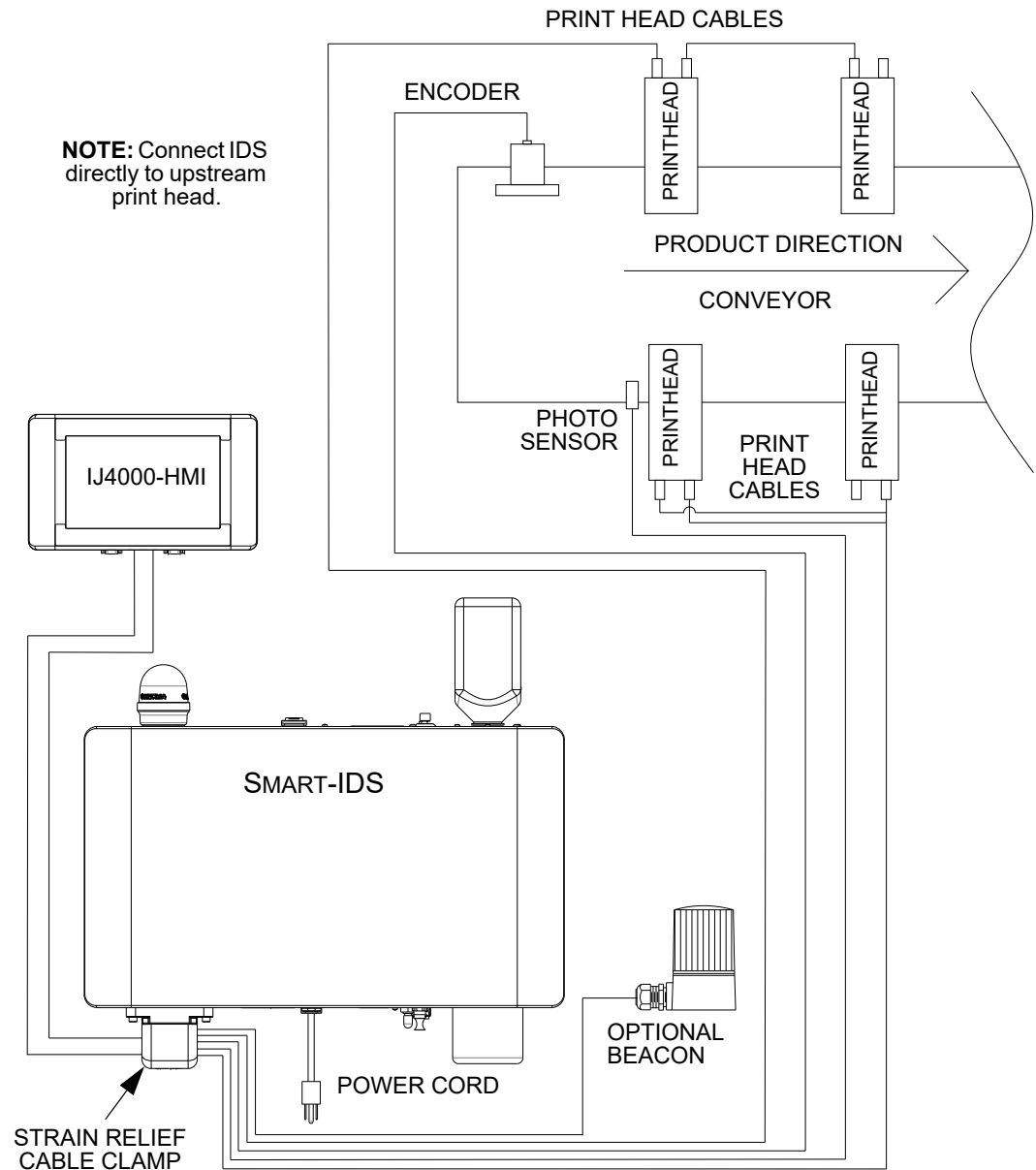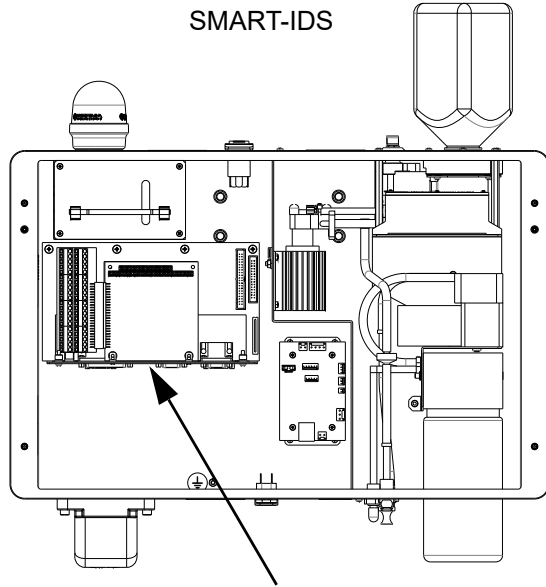
NOTE: In many applications, Photocell and Encoder may be shared from Task 1 to Task 2

INTERNAL CIRCUIT BOARDS

PRINT HEAD CABLES

PHOTOSENSOR / ENCODER CABLE

POWER CORD

I/O CABLE FROM SMART-IDS

ENCODER / PHOTOSENSOR CABLE

OPTIONAL I/O BOARD

TASK 2 INTERFACE BOARD CONNECTIONS

TASK 1 INTERFACE BOARD CONNECTIONS

COM2 *

COM1 *

ETHERNET / HMI *

USB / FILE BACKUP & TRANSFER ACCESS
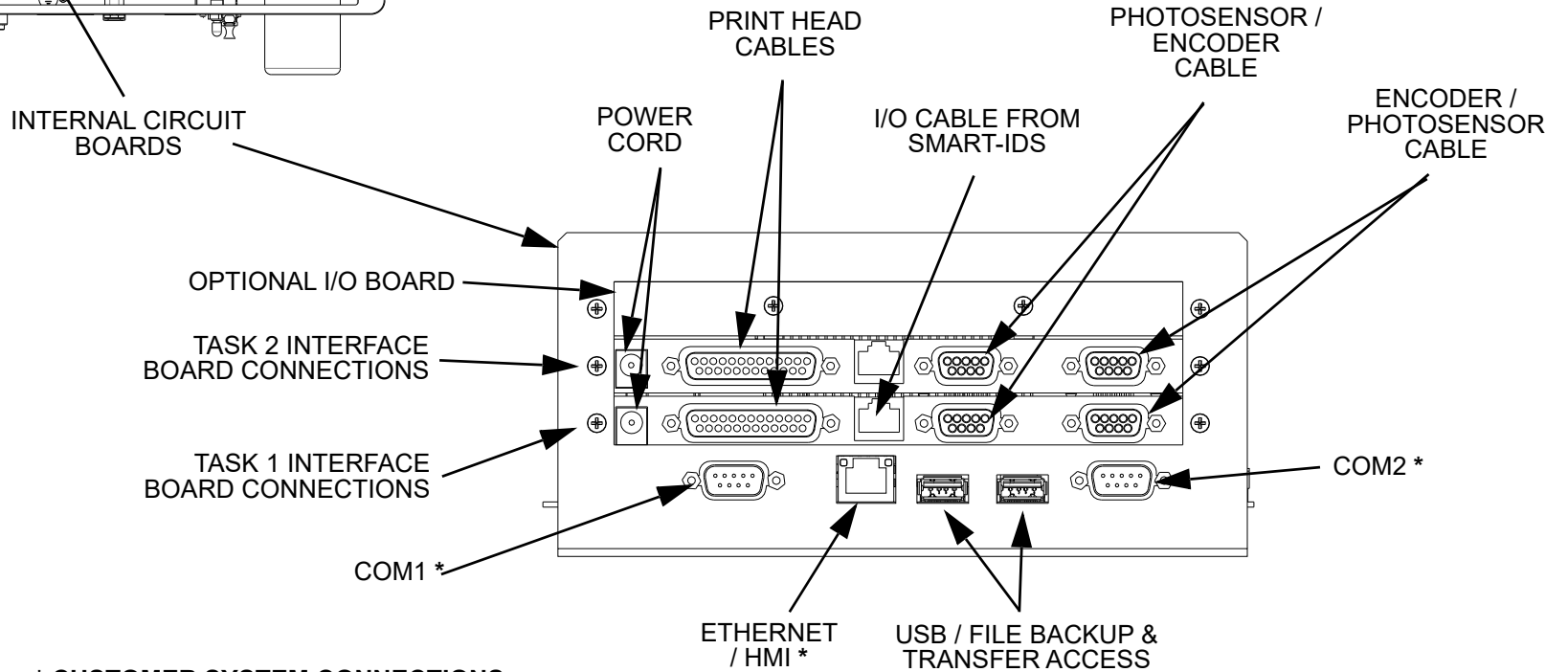
* CUSTOMER SYSTEM CONNECTIONS

(See Appendix A for details)

Step 7: Install Tubing

NOTE: Do not attempt plumbing this system before all mechanical mounting is completed.

1. After mechanical mounting is completed for the SMART-IDS and the print heads, remove all vent caps and install the supplied filter.

CAUTION

	REMOVE CAP
	INSTALL RED FILTER
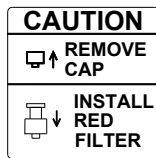
2. Route all ink and vacuum lines, and connect lines at the SMART-IDS. Refer to diagram at right for typical print head plumbing connections.

NOTE: Do not connect lines to print heads at this time.

INCORRECT

CORRECT

REMOVE AND SAVE CAP

FILTER

4,6mm [15ft] MAX

VACUUM

INK

SMART-IDS

DO NOT CONNECT TO PRINT HEAD YET

PRINT HEAD

CONVEYOR

REMOVE AND SAVE ALL 3 CAPS

INK OUTLET

PRINT HEAD

VACUUM PORT

VENT

INK FITTING (5361-329)

VACUUM FITTING (5765-721)

VACUUM FITTING (5765-721)

ONLY USED TO PRIME INK LINES

TEE FITTING (2460-120)

INK

VACUUM

DO NOT CONNECT TO PRINT HEAD YET

CHECK VALVE (5765-720)

STRAINER (5765-713)

STRAIGHT FITTING (5765-719)

"Y" FITTING (5765-717)

Step 8: Prime Ink Lines

⚠️ **CAUTION:**
- Ensure all vent caps, top and bottom, have been removed from the print head(s) and Smart-IDS.
- Ensure no tubing is connected to the print heads.

1. Remove the foil seal on the ink bottle and install it into the Smart-IDS reservoir. Clean and save the reservoir cap.

👆 **NOTE**: Never mix ink types because they are not miscible. Irreversible internal damage will occur.

2. Turn on the Smart-IDS.

3. At the print head located nearest the Smart-IDS, connect the ink supply and vacuum fittings to each other to form a loop.

4. The Smart-IDS vacuum cycle will be running as the print heads come up to temperature.

5. Disconnect the loop as soon as ink has flowed through the connected fittings. Wipe off both connectors.

6. Cut off the vacuum line fitting (5765-721) noted in red on the previous page. Remove the plug from the print head vacuum line and push the now raw tubing end into the print head vacuum fitting.

👆 **NOTE**: It is critical that all air be purged out of the ink lines prior to connection to the rear of the print heads.

7. Form a loop for the next closest print head. If the vacuum cycle is still running, allow ink to pass through the loop. Follow steps 5 and 6.

8. If the vacuum cycle stops running and ink lines need to be primed, form the fitting loop at the next print head, then press and hold the **ACS/Prime** button on the back of the print head for five (5) seconds. This starts a PRIME cycle. Follow steps 5 and 6.

9. Prime remaining ink supply tubing, following the steps above.

10. Level print heads and secure cables and tubing lines according to diagrams on the next page.

CAUTION
📺↑ REMOVE CAP
🖥↓ INSTALL RED FILTER

INK QUICK-DISCONNECT   VACUUM QUICK-DISCONNECT

CONNECTED
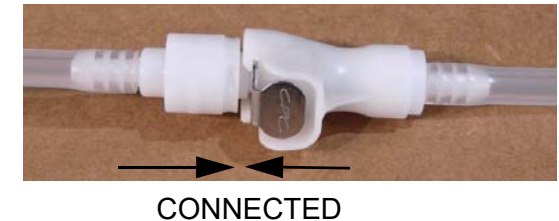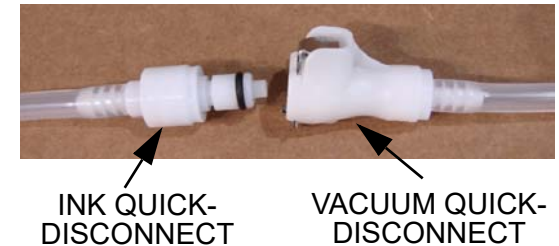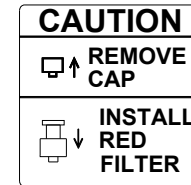
Confirm the print head(s) are level. The green LED indicates head is level. (384E Print Head is shown.)

WHEN UPPER LED IS RED, PRINT HEAD IS POINTED UP TOO FAR

WHEN CENTER LED IS GREEN, PRINT HEAD IS READY TO PRINT

WHEN LOWER LED IS RED, PRINT HEAD IS POINTED DOWN TOO FAR

ONLY USE SCANTRUE®INK
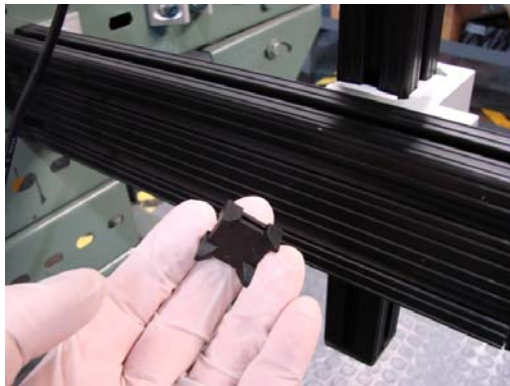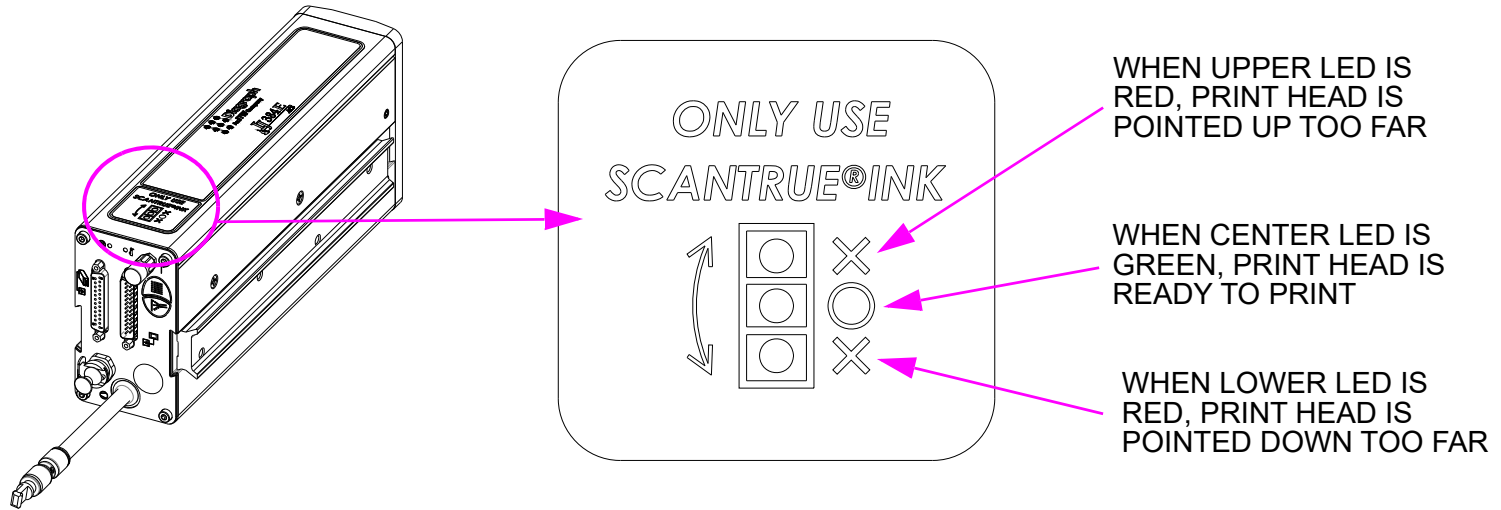
BRACKETRY KITS COME WITH TIE WRAP MOUNTS

INSERT TIE WRAP MOUNT IN BAR AND TURN 90°. INSERT TIE WRAPS INTO MOUNTS.
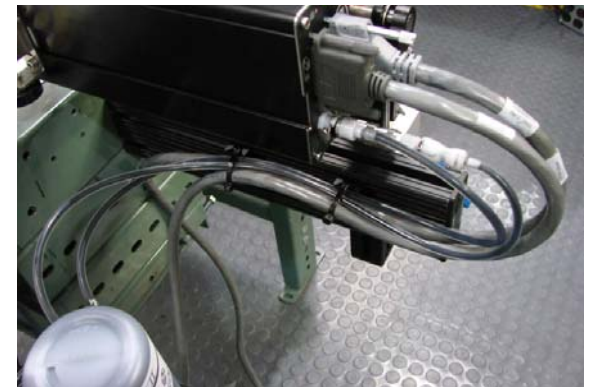
FORM AN 8" MINIMUM SERVICE LOOP FOR TUBING AND CABLE.

Step 9: Priming the Print Head and Testing Print Quality

1. Ensure caps and plugs (vent, vacuum, and ink inlet) from the rear of the print head have been removed and stored (see diagram).
2. Install the previously primed ink line and vacuum line into the rear of the print head.
3. Ensure all print heads are at operating temperature.
4. Ensure that the shipping cap is installed for priming.

NOTE: Print is disabled until the print head is fully heated. Wait until the "AT TEMPERATURE" LED is illuminated on the rear of the print head prior to any print sampling.

5. Press and hold the Prime button on the rear of the print head until the SMART- IDS Beacon flashes once. Repeat this step once more.
6. Remove the ship cap (see diagram) and store on the side of the 768E print head, or on the top of the 384E print head.

NOTE: Do not use lint-free wipes in the print channel; use foam swabs instead.

7. Use a foam swab to lightly wipe the orifice plate in a vertical downward motion.
8. Prime the print head by pressing the button once, quickly (ACS).
9. Print can be tested by slowly passing a sheet of paper in front of the print head after pressing the All Channel Print button. A solid image will print for approximately 3 seconds.
10. If the 384E sample is 50,8mm (2in) tall with no gaps, the print head is ready.

   If the 768E sample is 101,6mm (4in) tall with no gaps, the print head is ready.

384E PRINT HEAD
(See next page for 768E Print Head)

LEAVE THE RED VENT FILTER IN PLACE

REMOVE AND SAVE WHITE INK INLET PLUG

REMOVE VENT CAP

REMOVE AND SAVE PLUG

HEATER ON

AT TEMPERATURE LIGHT IS ILLUMINATED

ALL CHANNEL PRINT BUTTON

ACS / PRIME BUTTON

SNAP SHIPPING
CAP ON TOP OF
PRINT HEAD

TABS

SHIPPING
COVER
STORAGE

THUMB SCREWS

768E PRINT HEAD

LEAVE THE RED VENT
FILTER IN PLACE

REMOVE AND
SAVE WHITE INK
INLET PLUG

REMOVE
VENT CAP

REMOVE AND
SAVE PLUG

HEATER ON

AT TEMPERATURE
LIGHT IS
ILLUMINATED

ALL CHANNEL
PRINT BUTTON

ACS / PRIME
BUTTON

Missing Print

1. Hold a light-colored, absorbent towel under the front of the print head to catch potential ink overflow. The light-colored towel will reflect light, making the face of the print head easier to see.
2. Press and hold the **ACS/Prime** button for five (5) seconds until the SMART-IDS beacon light flashes once. Observe the 1-second ink flow out of the print head.
3. Inspect for very small air bubbles flowing out of the top of the print head and down the face. If bubbles are evident, repeat steps 1 to 3 three times.
4. Perform an ACS cycle, then slowly swipe a sheet of paper in front of the print head while pressing the **All Channel Print** button on the rear of the print head.
5. If any print is still missing after all air bubbles are purged, recap the print head, perform several Prime cycles, decap, and repeat the ACS.
6. Repeat the above steps as necessary.

Step 10: Mount Photosensor and Encoder

Photosensor

1. Position the photosensor (5760-383) upstream from the first print head. The maximum placement distance is 685,9mm [27in] from the photocell to the print head.

2. Refer to the instruction sheet included with the photosensor for calibration.

3. Refer to the "Photosensor Sensitivity Test" on page 41 of this manual to test the calibration.
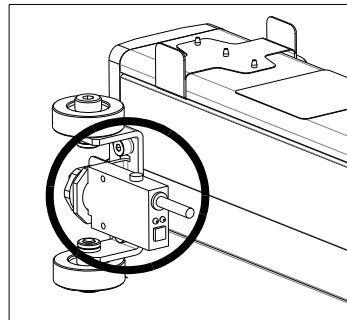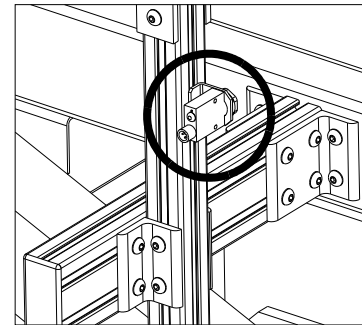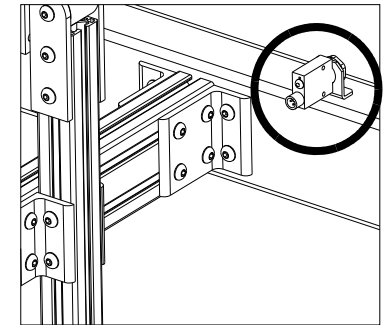
Print Head   Bracketry   Conveyor

Encoder

The encoder uses a wheel that rolls against the conveyor line to track the speed. It sends a signal to the controller, which makes adjustments for reported changes in the line speed.

It is not necessary to install the encoder immediately adjacent to the print heads. It is more important to place it where it will accurately measure the speed of the conveyor. Install it in contact with the conveyor, or with a wheel or roller moving the same speed as the conveyor.

The encoder's mounting bracket is spring-loaded. Adjust the spring collar to ensure that the encoder maintains stable contact with the conveyor.

CAUTION: Do not excessively pre-load the encoder wheel against the surface of the conveyor. A radial force of over 18,14 kg [40 lbs.] will reduce the life of the bearings.

Conveyor

Encoder

Encoder Wheel

Spring
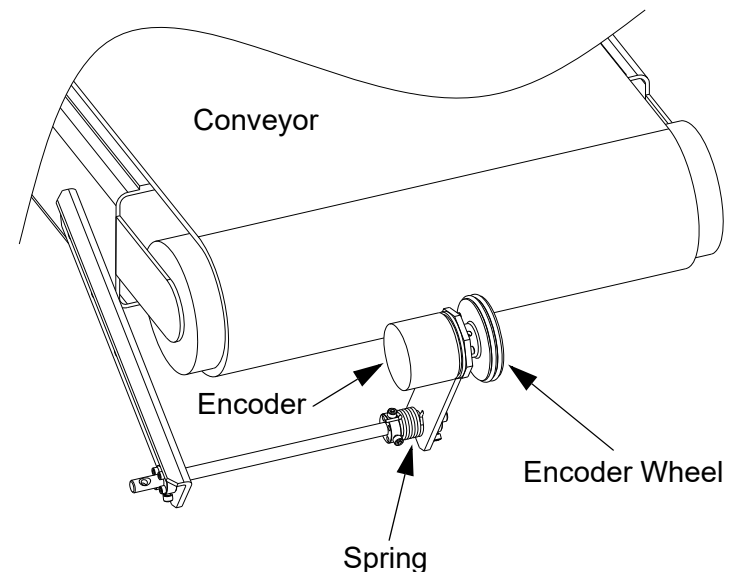
Step 11: Configure the Print Head via the Controller

NOTE: It is recommended that there is no message printing when re-doing the print head setup. If the warning message ("Changing the print head setup while printing may cause print problems. Continue?") is displayed, click **No**, then cancel the setup. Return to the Message Screen and cancel the print message before proceeding.

1. Select the **More** menu option, then select **Task Settings**,

2. Touch the **Setup Wizard** button.

3. Touch the box that represents the direction the product will move on the conveyor (as seen while standing in front of the IJ4000-HMI or Task 1 Print Head).

4. Touch the up/down arrows to set the number of print heads on each side of the conveyor.

5. Touch the **Next>** button.

6. Touch the first print head in the daisy chain. (If there is only one print head, this step is bypassed.)
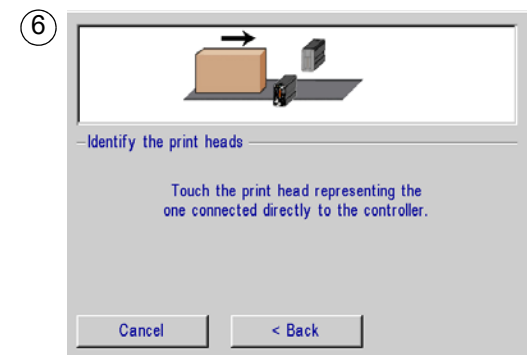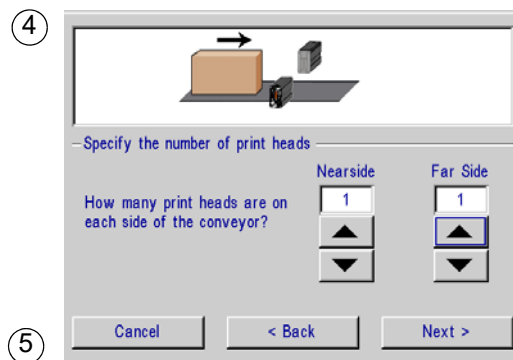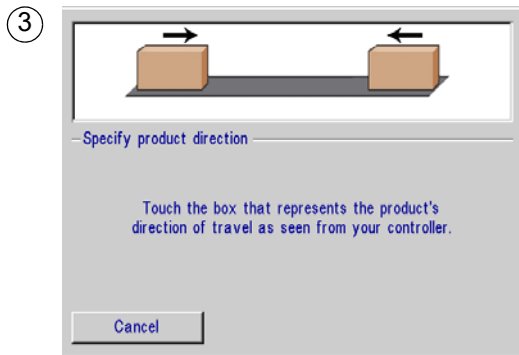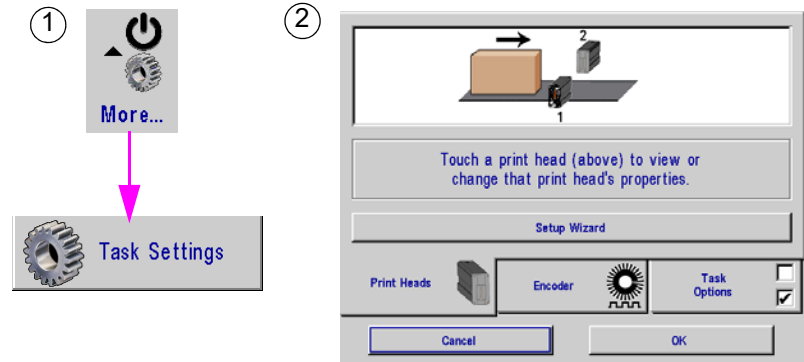
NOTES:

- The first print head in the daisy chain should be the top print head in the system, as this one will be printing the top line of data and will be the first one prompted to enter data.

- The procedure may be aborted by pressing Cancel or the Escape key at any time without changing the current print head setup.

- Repeat above steps for Task 2.

- Each Task can power up to two (2) IJ384E or one (1) IJ768E print heads.

7. Select the Print Head Type from the drop-down box.

8. Enter the distance between the photosensor and the vertical centerline of the print head. This may need to be fine-tuned after print setup. The maximum sensor offset for the IJ384E Print Head is 685,8mm (27in). If photosensor is mounted using a print head bracket, the offset is 53,3mm (2.1in).

9. Select the Encoder tab and touch the External Encoder icon.

10. If Internal Encoder is selected, type in the speed.

11. Select the **Print Heads** tab, then touch the next head to highlight it and continue setup.

12. Touch the **OK** button. Print Head setup is now complete.

⑦

⑧

Print Head Type
384
768

When 384 or 768 Print Head is selected, the ink type automatically sets to Scantrue II.

⑨ External encoder: 300 ppi

⑩ Internal timer
Line speed: 0,3 m/min

⑪ Touch a print head (above) to view or change that print head's properties.
Setup Wizard

⑫
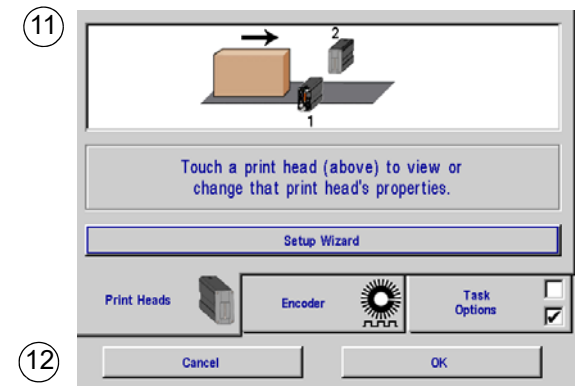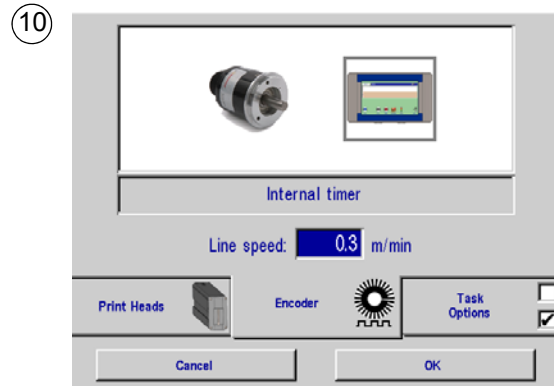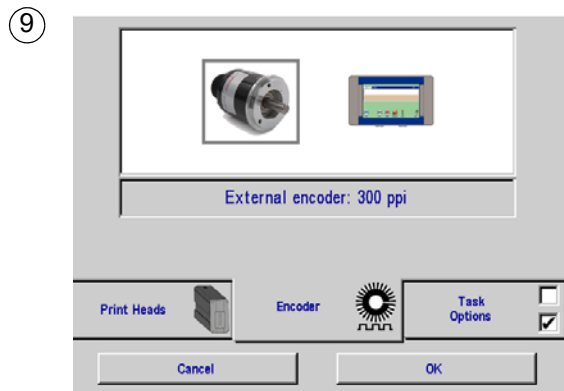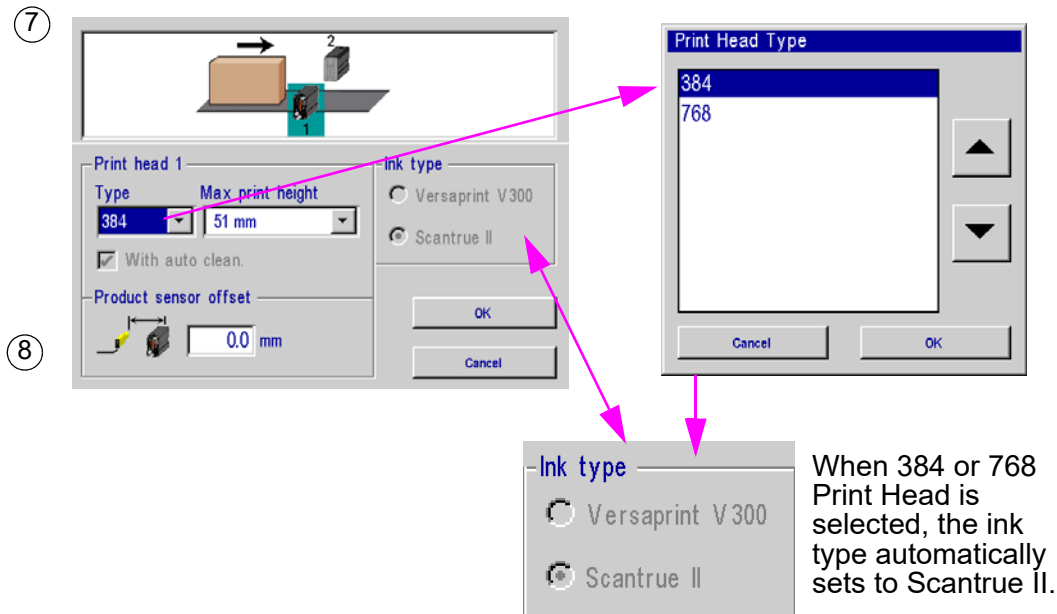
Touch any print head on the display to review or change the properties for that head. Touch the **Setup Wizard** button to repeat the setup procedure using the new setup as the default. Touch **OK** to return to the **Home Screen**.

Step 12: Create a Message

NOTE: Additional information on messages can be found in the IJ4000-HMI Controller Manual (5765-384).

From the **Home Screen**, select the **Messages** button, then select the **New** button.
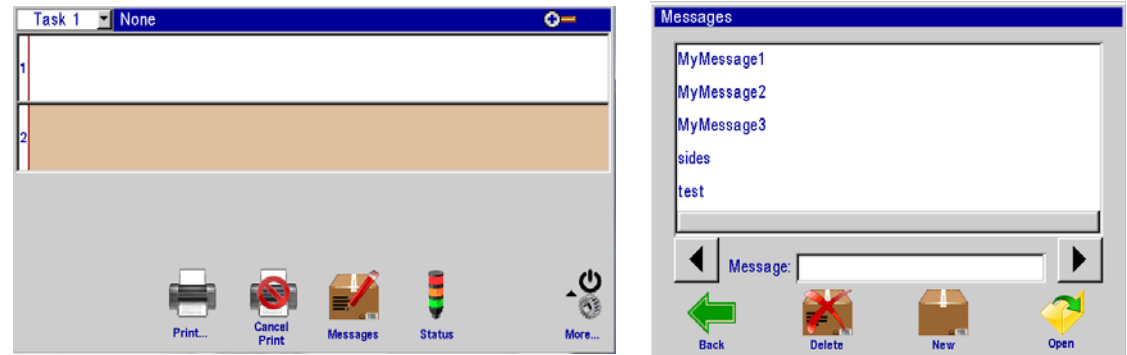
Create and save the message, then exit the message editor.

Time Code
Date Code
Message Display Area
Carton Ruler
Message Info
Next Field Button
Cursor
Field Properties
Cursor / Field Coordinates
Font Selection
On-screen Keyboard
Zoom
Text
Delete Button
Quick Save
Line Field
Menu
Product Side
Product Setup
Bar Codes
Count Code
Logo
Variable Field
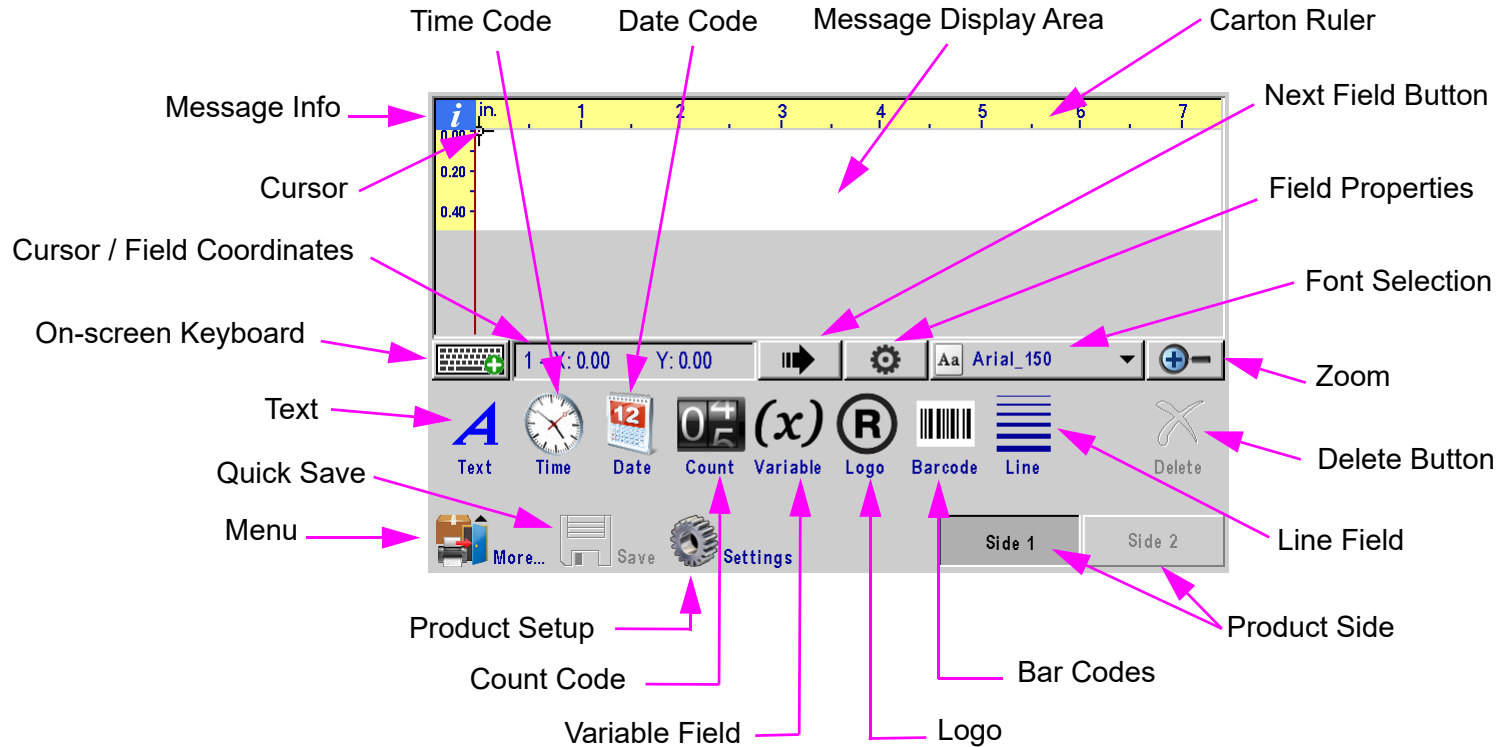
Step 13: Print a Message

1. From the **Home Screen**, press the **Print** button.
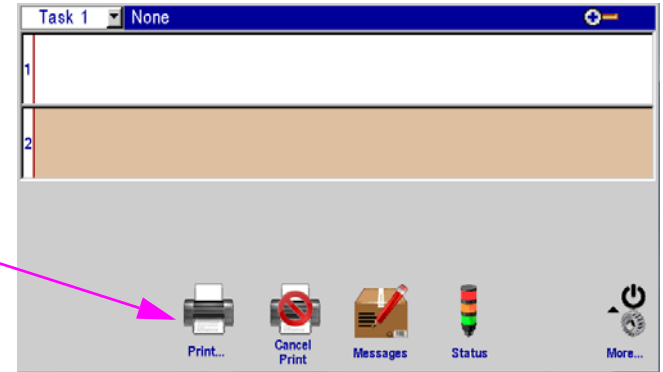
PRINT
BUTTON

2. Select the desired message to print, and press the **Print** button.
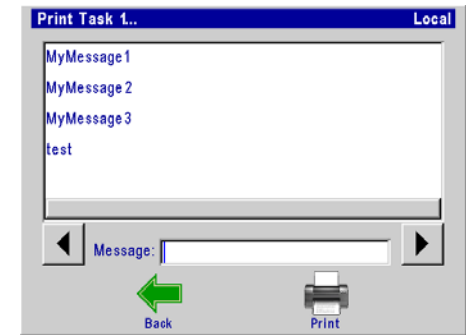
3. The message will print on the next photosensor trigger.

GREEN PAUSE INDICATOR =
READY TO PRINT

RED PLAY INDICATOR =
NOT READY TO PRINT

Section 3: Maintenance and Shutdowns

Following are the recommended maintenance procedures to keep the IJ4000 Impulse Jet system printing cleanly and efficiently.

System Maintenance

Intermittent (as required):

1. Be sure the photosensor is clean and free of debris.
2. Be sure the O-rings on the encoder wheel are present and not worn.
3. Be sure the nuts and bolts holding the bracketry in place remain tight.

Annually:

Replace encoder O-rings (5765-206).

Recalibrate Touch Screen.

Print Head Maintenance

Daily / Shift Startup / Periodic

Wear safety goggles when working with industrial inks or solutions!

The majority of print quality degradation is due to excessive debris deposits on the print head orifice plate that disrupt the ink droplet path. For best preventative maintenance practices, do the following:

1. Remove excessive debris build-up (corrugate dust, glue strands, and the like) on and around the front of the print head by using maintenance spray n-Propanol (5760-695) on a clean lint-free cloth (6600-171) and wiping the front plate and enclosure. If debris build-up is noted on the enclosure and rear of the print head, then wipe those clean, too.

NOTE: DO NOT SPRAY n-Propanol DIRECTLY ON THE PRINT HEAD OR ANYWHERE NEAR THE ORIFICE PLATE.

2. Using a sponge swab (5760-832), rub the orifice plate lightly from top down in a vertical direction while ink is flowing during an ACS (Automatic Cleaning Systems) cycle. The ACS button is located on the rear of the print head. DO NOT USE n-Propanol directly on the orifice plate.

3. Press the ACS button one more time to ensure channel priming, but do not swab this time.

4. Wipe the front plate with a clean lint-free cloth to remove any excess ink.

SWAB DOWN

ACS/PRIME BUTTON
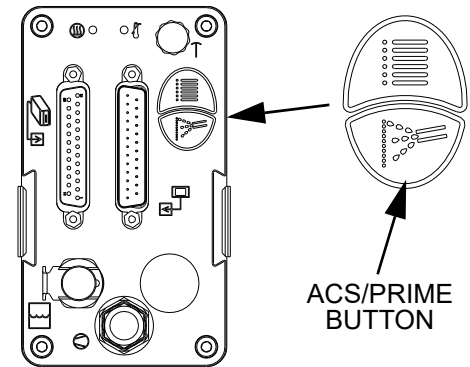
Shutdowns of 1 Week to 3 Months

Shutdown:

1. Disconnect SMART-IDS from mains power.

2. Spray the appropriate cleaning solvent on a lint-free cloth and, before installing ship cap, lightly wipe the front of the print head to remove foreign debris.

3. Install shipping cap onto the front of the print head, and install vent cap onto the rear of the print head.

SHIPPING CAP STORAGE

TABS

SHIPPING CAP STORAGE

THUMB SCREWS

VENT CAP
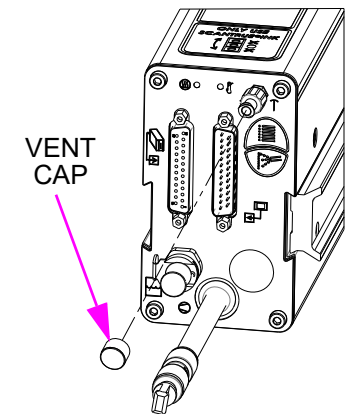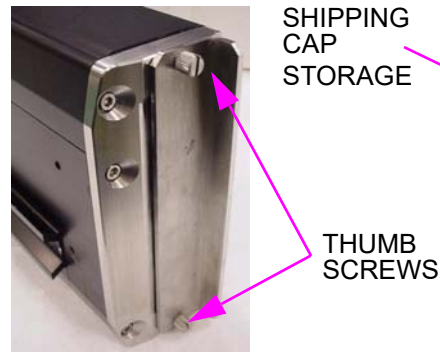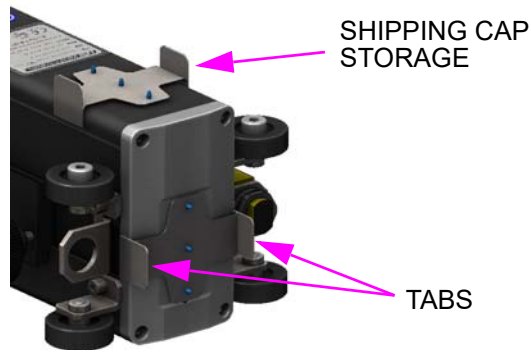
Startup:

Follow instructions in "Step 9: Priming the Print Head and Testing Print Quality" on page 21.

Shutdowns of 3 Months or More

1. Follow recommendations for Shutdowns of 1 Week to 3 Months (see above).

2. It is recommended that the print head system be flushed with ScanTrue Flush Solution and that ScanTrue Flush Solution be left in the print head and SMART-IDS during the storage period. (See "Consumables" on page 77 for part numbers.) Follow instructions in document 5760891N. Flush Solution can remain in the print head for one year from the date of flushing.

ACS - Automatic Cleaning System

NOTE: If the beacon on the SMART-IDS is in any way illuminated or flashing, the ACS will not activate. Make sure all ink faults are corrected before attempting an ACS.

The ACS is an invaluable tool for routine cleaning of loose debris from the print engine face. The images below demonstrate print before and after the ACS.

BEFORE ACS

AFTER ACS

The ACS feature can be accomplished by three methods.

1. Manually, from the rear of the print head: Press and hold the **ACS/Prime** button for 1/2 to 1 second. The ACS cycle will initiate.

2. Manually, from the controller **Purge Screen**:

   •On the IJ4000 Home Screen, touch the **More** menu button to open the More Menu.

   •Touch the **Purge** button to open the Purge Screen.

   •Select the print head to be cleaned by touching that print head.

   •Touch the **Clean Print Head** button to clean the selected print head.

   Once a print head has been cleaned, verify that all channels are printing properly by touching the **All Channel Print** button located on the back of the print head. Swipe a sheet of paper or other material across the front of the print head as the head purges. The print head purges for three seconds each time the **All Channel Print** button is touched.

3. Automatically, from the controller **Auto clean** menu: The IJ4000 can also be programmed to automatically clean the print heads during regular down times in the production schedule in increments of 30 minutes, or on a weekly schedule.
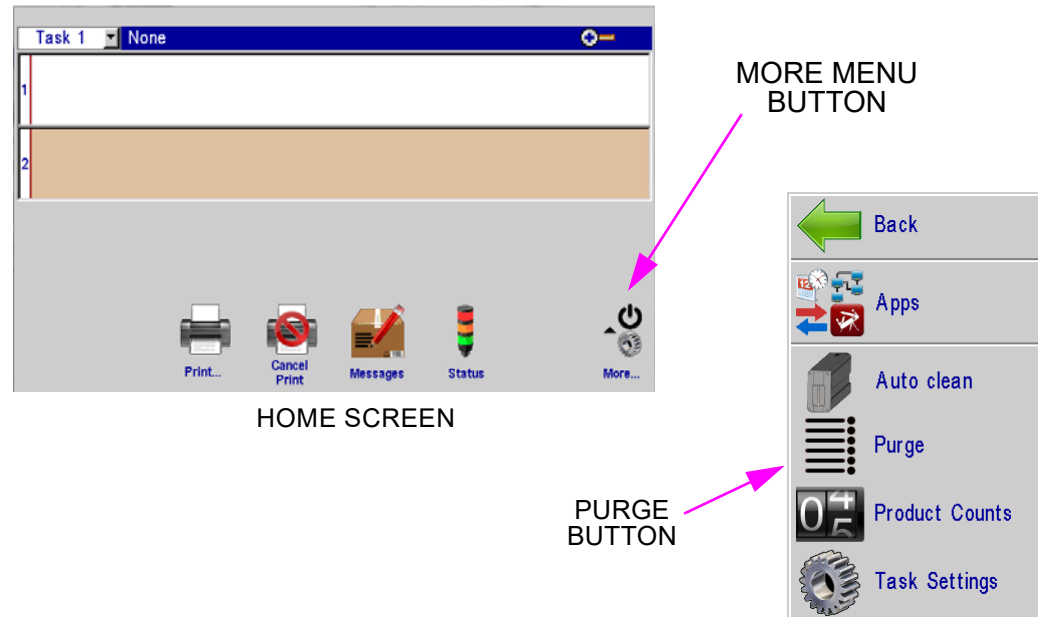
HOME SCREEN

MORE MENU BUTTON

PURGE BUTTON

MORE MENU
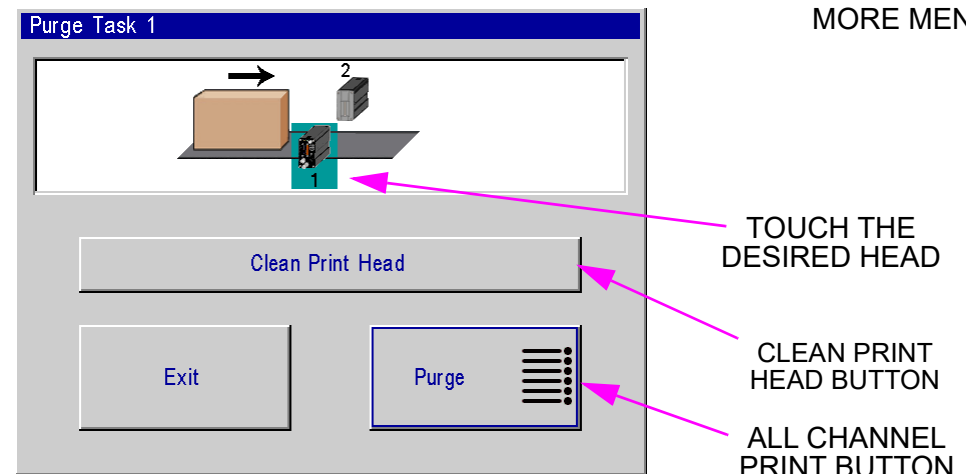
TOUCH THE DESIRED HEAD

CLEAN PRINT HEAD BUTTON

ALL CHANNEL PRINT BUTTON

PURGE SCREEN

SMART-IDS Maintenance

Changing Ink Containers

⚠️ **CAUTION:** Replace ink with ScanTrue II® ink only.

The Ink Status Beacon illuminates when the ink bottle is empty, and the pump is disabled. This alerts the operator to ready a new bottle of ink, and allows the operator at least five minutes to change the bottle before printing is disabled. If the ink bottle is not replaced within five minutes, print will be disabled on all "Tasks" and the beacon will flash slowly.

Shutdowns of 1 Week to 3 Months

During planned shutdown periods of 1 week to 3 months, as well as when storing spare print heads:

1. Remove the ink bottle, close the reservoir vent cap, and install the reservoir ship cap.

Shutdowns of 3 Months or More

1. Follow the recommendations of Shutdowns of 1 Week to 3 Months.
2. It is recommended that the print head system be flushed with ScanTrue Flush Solution and that ScanTrue Flush Solution be left in the print head and SMART-IDS during the storage period. (See "Consumables" on page 77 for part numbers.) Follow instructions in document 5760891N. Flush Solution can remain in the print head for one year from the date of flushing.

Annually

Replace the vent filter on the SMART-IDS.

Storage Life of a FACTORY SEALED Bottle of Ink

- ScanTrue II: 12 months from date of manufacture.
- ScanTrue II Plus: 18 months from date of manufacture.
- Recommended storage temperature: 4° to 40°C (40° to 104°F).
- Recommended storage relative humidity: 5 - 90% relative humidity with no condensation.

Temperatures above or below the recommended storage temperature for a period greater than one week will reduce the storage life of the ink.

NOTE: Do not shake the bottle of ink before use. Agitating the ink may introduce air into the Print Head. If shaken, the bottle must sit for at least two hours before use.

Use Life of an OPENED Bottle of Ink

- ScanTrue II: 3 months from opening.
- ScanTrue II Plus: 6 months from opening.

Exposure to air, temperature and relative humidity will affect the useful life of the ink.

Section 4: Troubleshooting

The IJ4000 ink jet system incorporates advanced designs, both in hardware and in software. However, if the system ever fails to perform properly, some built-in indicators will help in troubleshooting. This section will help minimize system downtime and explain some of the diagnostic features built into the system.

Print Quality

This section shows examples of various print problems and actions which should be taken to improve the print.

Problem: <u>Minor fractures in print channels.</u>

Possible Cause: Debris on front plate, air in channel.

Action: Run Automatic Cleaning System (ACS), using a foam swab to assist in removal of debris.

Problem: <u>Missing Channels and Channel fractures in print channels.</u>

Possible Cause: Excessive debris on front plate, air in channel.

Action: Wipe front plate and run Automatic Cleaning System (ACS), using a foam swab to assist in removal of debris.

Problem: <u>Missing print channels.</u>

Possible Cause: Air in channel.

Action: Run Automatic Cleaning System. If air cannot be removed by running an ACS cycle, run a Prime Cycle per instructions in "Missing Print" on page 23.
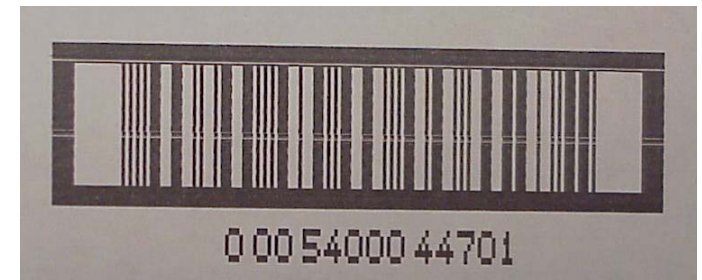
Problem: Missing bottom print channels.

Possible Cause: Ink build-up on lower orifices.

Action: Wipe front plate with sponge swab (5760-832) and run Automatic Cleaning System.
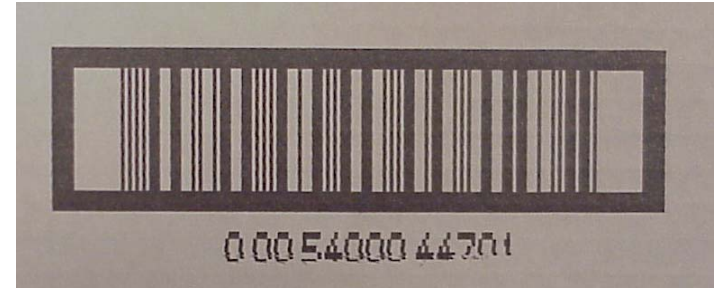
Problem: Fuzzy Print.

Possible Cause: Print head too far away from substrate.

Action: Move print head to within 1/8" from product.
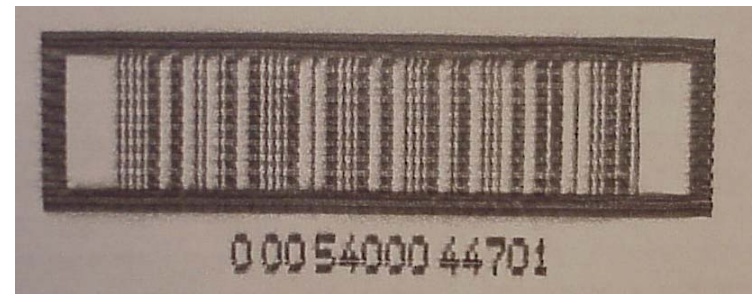
Problem: Occasional checkerboard print pattern.

Possible Cause: Encoder slipping or bouncing on belt.

Action: Tighten encoder on belt; replace encoder o-rings, if required; replace conveyor belt with smooth seamless type belt.

Problem: Stretched out, light print, checkerboard pattern.

Possible Cause: Incorrect encoder, or incorrect line speed (set too low) if using internal encoder.

Action: Check for correct encoder (must use part # 5760-820-IJ).
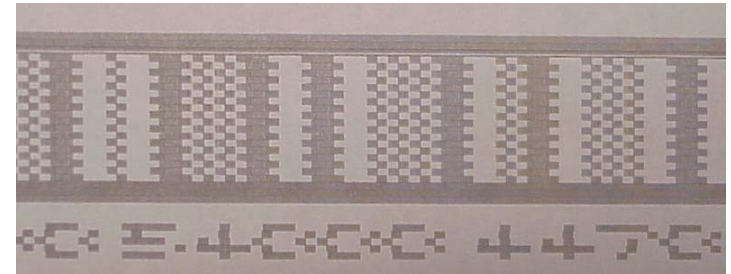
Problem: Short image, dark print, checkerboard pattern.

Possible Cause: Incorrect encoder or wheel size, or incorrect line speed (set too high) if using internal encoder.

Action: Check for correct encoder (must use part # 5760-820-IJ).
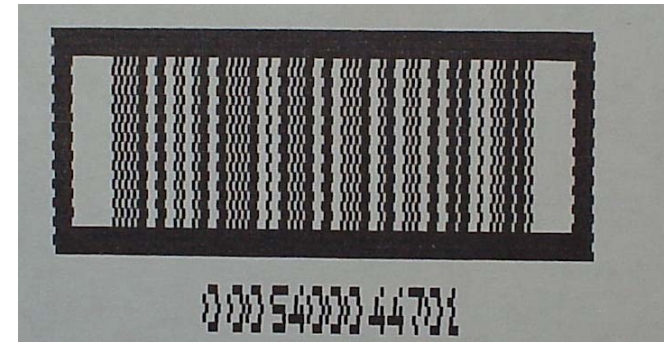
Problem: Backwards print.
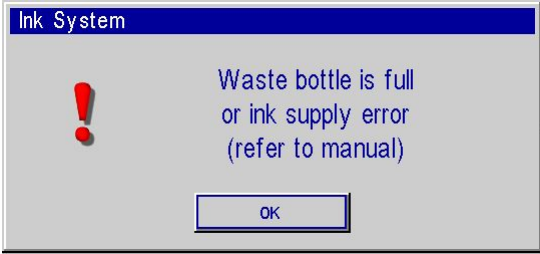
Possible Cause: Incorrect print direction specified in set-up.

Action: Re-do print head set-up to specify correct direction.

IJ4000 Impulse Jet System Trouble-Shooting

SMART-IDS:

System Symptom	Possible Cause	Operational Test Method	
Ink not pumping to Print Head			Consult "Detailed Guide to Determine Proper Ink Flow Issue Resolution" on page 42.
No vacuum at Print Head during ACS Cycle. Ink is over-flowing the Print Head	Vacuum Tubing & Connections	Confirm all tubing connections are tight between SMART-IDS and every print head. Confirm that the waste bottle is tight and not cross-threaded. Confirm that the in-line vacuum filter is tight. Do not over-tighten.	
	Power Supply	Ensure SMART-IDS switch is turned on.	
		Check for power LED on Internal Power Supply Board. If LED is illuminated, check power supply output on P2. It should be 12VDC.	
	PC Board	Check the LED indicators and connector voltages on the board.	
		LED3: Green; indicates a print head is signaling for the Vacuum Pump to turn on.	
		LED5: Red; indicates the Waste Bottle is full.	
		LED6: Red; turns on, off, and flashes with the beacon. Off indicates ink is OK, On indicates ink is low, Slow Flash (1Hz) indicates ink is out, and Fast Flash (6Hz) indicates that the Waste Bottle is full or the pump was turned on for 10 seconds.	
		J4: Vacuum Pump connector; 12VDC when Vacuum Pump is on.	
	Vacuum Pump	Ensure all tubing is connected between the Print Head and the SMART-IDS. Make sure the Ink Waste Bottle is fully tightened. Open SMART-IDS and remove any clogs in the line. Initiate an ACS Cycle, and listen for the pump.	
		Check for 12VDC at Vacuum Pump.	

S<small>MART</small>-IDS (continued)

System Symptom	Possible Cause	Operational Test Method
Liquid Pump and Vacuum Pump do not turn on, and light is off on power switch	Power Supply	Ensure SMART-IDS switch is turned on. Check for power LED on Internal Power Supply Board. If LED is illuminated, check power supply output on P2. It should be 12VDC.
Beacon light does not illuminate at ink out	Power Supply	Ensure SMART-IDS switch is turned on. Check for power LED on Internal Power Supply Board. If LED is illuminated, check power supply output on P2. It should be 12VDC.
	PC Board	Check the LED indicators and connector voltages on the board. LED5: Red; indicates the Waste Bottle is full. LED6: Red; turns on, off, and flashes with the Beacon. Off indicates ink is OK, On indicates ink is low, Slow Flash (1Hz) indicates ink is out, and Fast Flash (6Hz) indicates the Waste Bottle is full or the pump was turned on for 10 seconds. J5: Power connector; 12VDC when power is turned on. J1: Beacon connector; 12VDC when Beacon is on.
	12V Beacon Bulb	Unplug the Beacon from the board and check the resistance of the bulb. If the bulb is open, replace it.

Impulse Jet Print Head:

System Symptom	Possible Cause	Operational Test Method
ACS Cycle will not operate	No SMART-IDS to Controller Cable connection. No SMART-IDS power. No Controller to Print Head connection.	Inspect SMART-IDS communication cable and ensure connection to Interface Board. See "Step 6: Electrical Cable Connections" on page 16.
Ink overfills and drips after ACS Cycle	Vacuum Tubing & Connections	Confirm all tubing connections are tight between SMART-IDS and every print head. Confirm that the waste bottle is tight and not cross-threaded. Confirm that the in-line vacuum filter is tight. Do not over-tighten.
Print Head will not heat, "At Temperature" LED never turns on	Print Engine or PC Board	Return print head to manufacturer.
Missing print.	Air in Print Head	Air in the Print Head is the most likely cause of missing channels. Refer to "Missing Print" on page 23 for bleeding procedures.
Ink Reservoir in Print Head does not refill, or no ink pumps out during an ACS or Prime Cycle. (384E)	Solenoids or PC Board	Return print head to manufacturer.
Print Head will not print. (384E)	PC Board	Return print head to manufacturer.
Ink Reservoir in Print Head does not refill, or no ink pumps out during an ACS or Prime cycle. (768E)	Solenoids	Remove power from the Print Head. Disconnect solenoid cable harness. Purge, intake, and return solenoids are pinned on 1-2, 3-4, and 5-6, respectively. The Intake Valve controls ink into the Reservoir, and the Purge Valve controls ACS and Prime. Check the respective valve pins for resistance. An open coil should be replaced.

Impulse Jet Print Head (continued):

System Symptom	Possible Cause	Operational Test Method
Ink Reservoir in Print Head does not refill, or no ink pumps out during an ACS or Prime cycle. (768E) (Continued.)	PC Board	Check the LED indicators on the board. LED2: Green; indicates Print Head is requesting SMART-IDS to turn Liquid Pump on. LED9: Green; indicates Intake Solenoid Valve is open. LED8: Green; indicates Print Head Reservoir is full. LED3: Green; indicates Print Head Reservoir is low and Ink Out Timer has expired.
Print Head will not print. (768E)	PC Board	Make sure all print head cables and the print engine cable are seated at each end. Check the Test Points and LED indicators on the board. TP1: High voltage supply to driver IC (U9). The voltage level is set via a sense resistor in the print engine (40-150 VDC). LED6: Green; indicates high voltage is low.

Photosensor Sensitivity Test

This test will determine if the photosensor sensitivity is adjusted correctly for the application.

1. Place object approximately 6,4mm (.25in) in front of photosensor; photosensor should sense object.
2. Place object near the center of the guide rails; photosensor should sense object.
3. Place object on far guide rail; photosensor should not sense object.
4. Check that objects on the far side of conveyor do not trip the photosensor.
5. Check that color differences in product do not cause multiple photosensor trips at the farthest sensing distance.

NOTE: The test object should be a sample of the actual product. For photosensor sensitivity adjustment procedure, refer to the photosensor manufacturer's instructions.

NOTE: If the red LED on the photosensor fails to illuminate when an object is placed in front of (but not touching) the photosensor, it indicates that the photosensor is disconnected, or the power supply or photosensor has failed.

Encoder

Navigate the IJ4000 to the status screen. If the line speed displays a value comparable to the known line speed, then the encoder is functioning correctly. If the line speed displays "0", then check electrical connections to the encoder and IJ4000 PCB. Refer to "Encoder" on page 56 for additional information.

Detailed Guide to Determine Proper Ink Flow Issue Resolution

Introduction and Ink Flow

Proper ink flow through the Impulse Jet ink circuit is critical, not only to being able to print, but also to maintain the IJ Print Heads in proper condition without introducing air into the print engine.

Most often, issues with ink flow through the Impulse Jet System will be indicated by the following error message. The following procedure should be used to identify the proper issue and resolution.

```
┌─────────────────────────────────────┐
│ Ink System                          │
├─────────────────────────────────────┤
│           Waste bottle is full      │
│    ❗     or ink supply error        │
│           (refer to manual)         │
│                                     │
│            ┌──────────┐             │
│            │    OK    │             │
│            └──────────┘             │
└─────────────────────────────────────┘
```
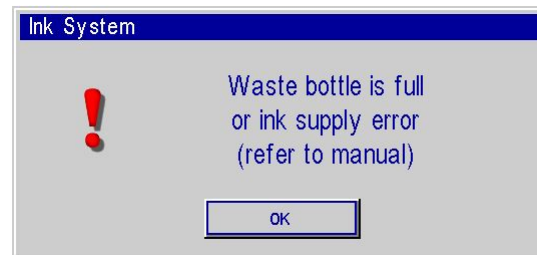
Good Ink Flow can be subjective; following are guidelines for determining that flow:
- While pump is on and there are no ink supply tubing obstructions or damage, there will initially be 20-25 psi at the exit.
- Depressing the male QD will flow fast (5-10 mL/sec), not drip, drip.

General Maintenance Checks Prior To Troubleshooting

Prior to troubleshooting for specific issues, review the general maintenance of the IJ4000 Print System:

1. Check and correct if Ink Waste Bottle is full. If so, remove, and dispose of according to local regulations. (NOTE: Ink Waste Bottle has a "float switch" which should drop and clear error by removing the bottle.)
2. Make sure Ink Bottle is properly installed, has adequate ink, and is not expired.
3. Check and correct all vent ports on Smart IDS and Print Head(s) to make sure they are not capped, and filters are not obstructed.
4. Check and correct Ink supply tubing for any obvious signs of damage or interference (bends, kinks, loops, equipment placed on top of lines, cracks, or cuts).
5. Check and correct all cable connections. Look for signs of damage and that connectors are tight.
6. Check and correct area of print system for signs of ink leaks or spills.

Print Head / Ink Supply Tubing / IDS Diagnosis

⚠ Waste bottle is full or ink supply error (refer to manual)

Ok

The purpose of this chart is to troubleshoot an Ink Flow issue to isolate it from Print Heads, Plumbing, or an Ink Delivery System (IDS).

Go to first Print Head, disconnect Ink Supply Tubing (have wipes, be careful of drips).

Does IDS have a Flashing Red Beacon?

No → CAUTION: Run an ACS from back of head, carefully depress the male fitting plunger (from the Ink Supply Tubing) into a wipe or container and observe ink flow from fitting.

Yes

CAUTION: Cycle power on the IDS, when IDS powers up and while pump is running, carefully depress the male fitting plunger (from the Ink Supply Tubing) into a wipe or container and observe ink flow from fitting.

(Continued on next page...)

(Continued from previous page.)

Is Ink flowing well from Ink Supply Tubing /Fitting (not dripping, actual flow)?

No → The issue appears to be related to the Ink Supply Tubing and/or IDS.

→ Disconnect the Ink supply tubing from the Smart IDS.

↓

Using extra male fittings and a short length of tubing, create a service tube to check the IDS.

↓

CAUTION: Connect the service tube to the Smart IDS:
1) Ink should flow into the tube by gravity.
2) Check for powered flow as described above. If beacon is on, cycle power; if no beacon, use ACS.

↓

Is Ink flowing well from service tube?

Yes (from first diamond) ↓

Check the remaining Print Heads on the system using the method described for the first head.

↓

Is Ink flowing well from Ink Supply Tubing /Fitting of remaining heads?

No →

Yes ↓

The issue appears to be printhead related.
Please see Print Head Determination and Actions.

The issue appears to be the Smart IDS.
Call Technical Support for further troubleshooting and/or schedule a Technician onsite.

No ↓ / Yes ↓

The issue appears to be Ink Supply Tubing.
Replace All Ink Supply Tubing and Fittings (PN 5765208, 1301468, 5765209).

Print Head Determination and Actions

If following the troubleshooting flow chart has determined that a print head is causing the Ink Flow fault, then several steps are needed:

1. Determine which print head is at fault (see below).

2. Replace (repair) the print head.

The majority of print head repair should take place at the factory by qualified technicians. The best support plan for customers is to use the ITW AMP or PEP support programs if in the event of needing a print head replacement.

To determine which print head is at fault on systems with more than one print head, use these steps:

1. Power down the system by toggling off the power switch at the Smart IDS.

2. Disconnect the print head cables from all print heads.

3. Disconnect the Ink supply tubing from each print head.

4. Go to the first print head, reconnect the print head cable.

    a. Make sure that the print head cable connects directly to the Smart IDS (Interface Card/Task Board).

    b. 384 print heads that were "daisy chained" may require switching cables to make a direct connection.

5. Connect the Ink supply tubing.

6. Power on the Smart IDS and observe function of the Smart IDS and its pump.

    a. The print head reservoir should refill in 2 seconds, at which time the pump should stop, and the Smart IDS indicator beacon should display green. This indicates that the print head is in good condition.

    b. If the pump runs until the Smart IDS indicator beacon displays fast-flash red and then shuts off, this indicates that the print head has an internal issue and should be replaced.

7. Power down the system, and disconnect the print head cable and Ink supply tubing.

8. Repeat steps 4 through 7 for the remaining print heads in a logical procession.

Impulse Jet Ink Components and Ink Circuit
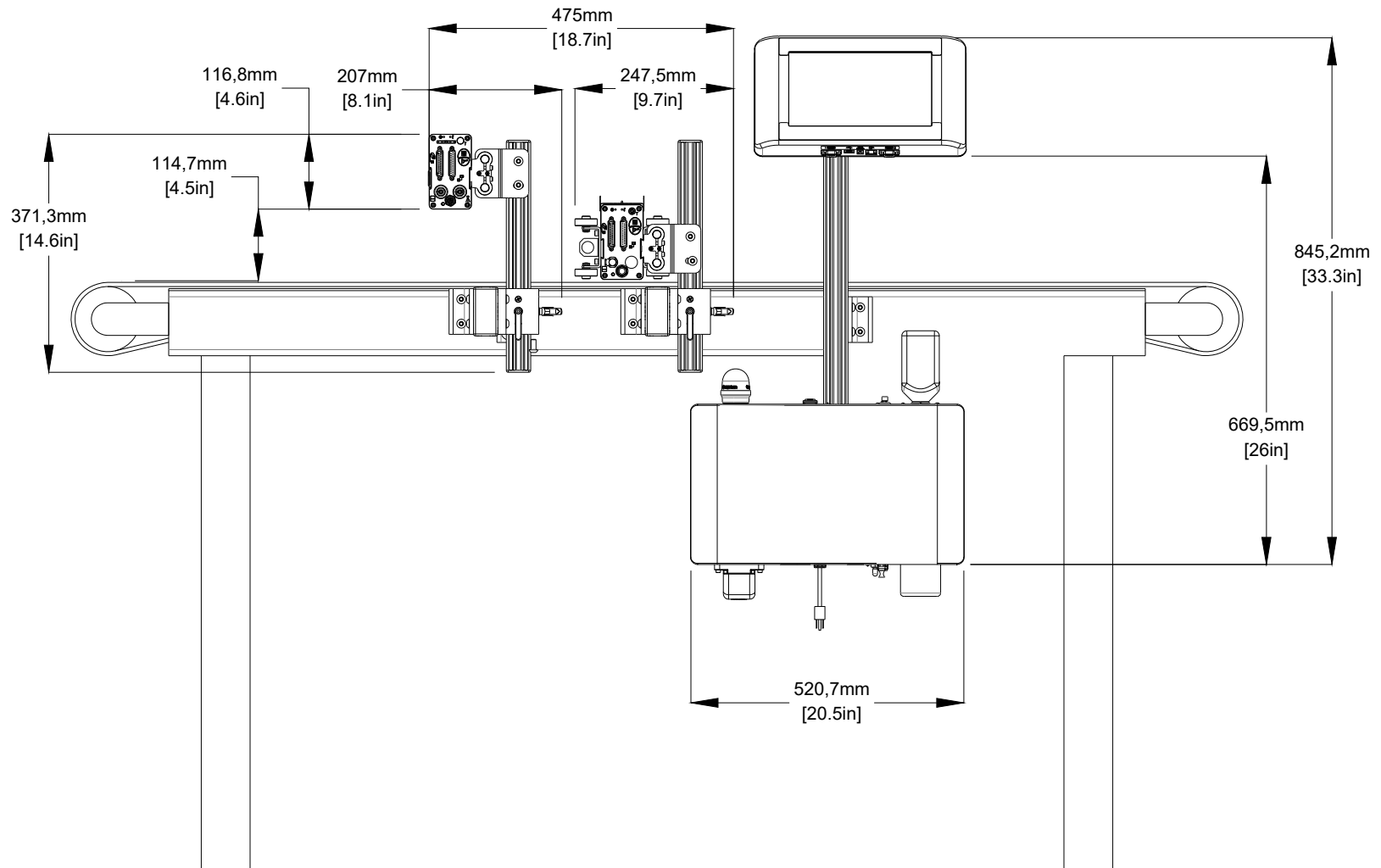
The Impulse Jet Ink Circuit is gravity fed from the ink supply tubing to the 5760335 pump, and then out to the print heads.
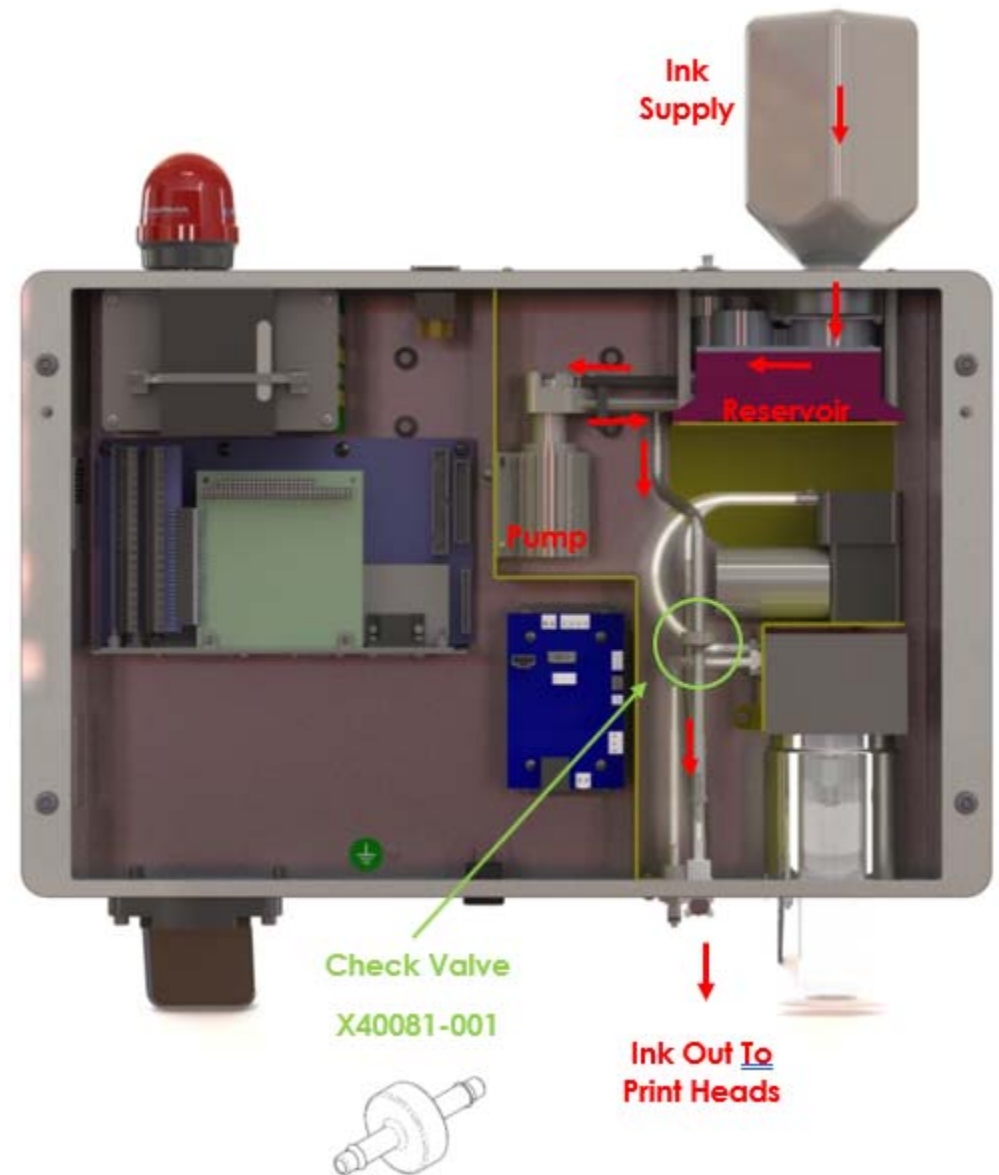
Appendix A: System Specifications

System

475mm [18.7in]

116,8mm [4.6in]

207mm [8.1in]

247,5mm [9.7in]

114,7mm [4.5in]

371,3mm [14.6in]

845,2mm [33.3in]

669,5mm [26in]

520,7mm [20.5in]

SMART-IDS

Size
Height: 336.6mm [13.25in]
Width: 520,7mm [20.5in]
Depth: 143,5mm [5.65in]
Weight: 10,0 kg [22.1 lbs]
Cable and Tubing Clearance: 127mm (5in) from the bottom of the enclosure.

IP Rating
IP54 (estimated)

Enclosure
Stainless steel

Ink Filtration
25 micron built in supply reservoir

Electrical
Input: For Non-European Versions: 115VAC, 1.5A, 60Hz
     For European Versions: 230VAC, 0.5A, 50Hz.
Output: 24VDC, 2A

Normal Operating Pressure Range
0 psi to 30 psi (approximately) pump output when operating

Ports
(2) RS-232 Ports, (1) USB Port
(1) 100 base-T Ethernet Port
Factory set IP Address: 10.1.2.3

Environment
Ambient operating temperature: 5°C to 40°C (40°F to 104°F)
Operating humidity: 10% - 90%, non-condensing

Tubing Limitations
Maximum vertical tube length (bottom of SMART-IDS to bottom of highest print head) = 6,1m (20ft) ink pump limitation.
Maximum height of SMART-IDS or tubing above print head= 914,4mm (36in) vacuum pump limitation.
(See "Step 7: Install Tubing" on page 18.)

Number of Heads Allowed
384E Print Heads - 4
768E Print Heads - 2
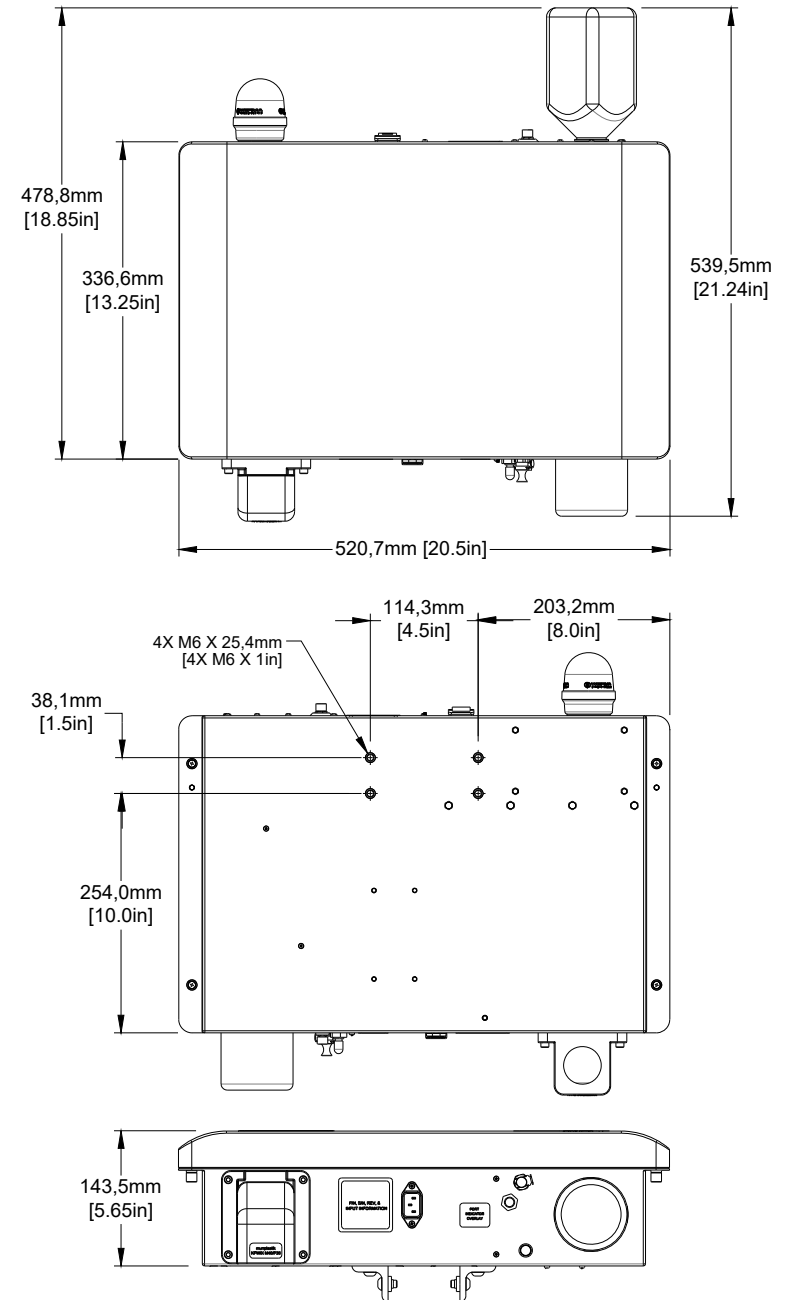
IJ4000-HMI Controller
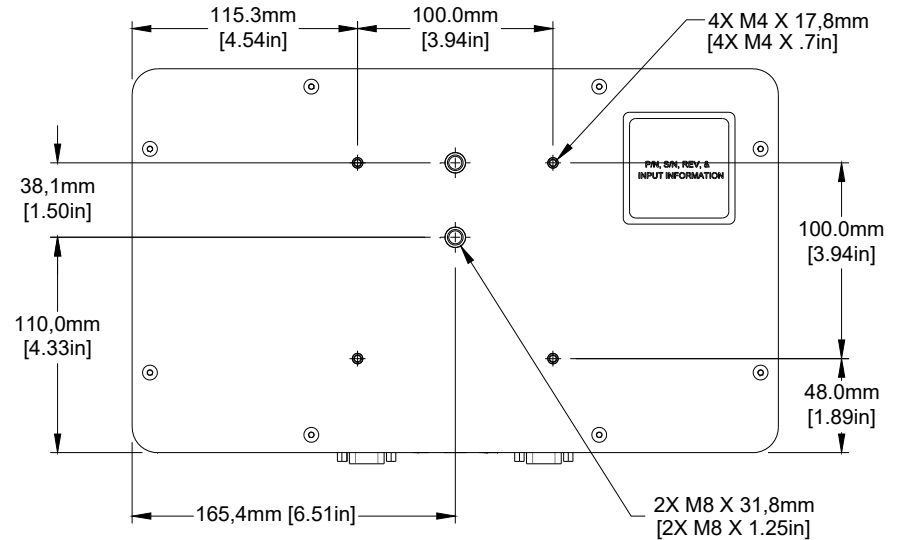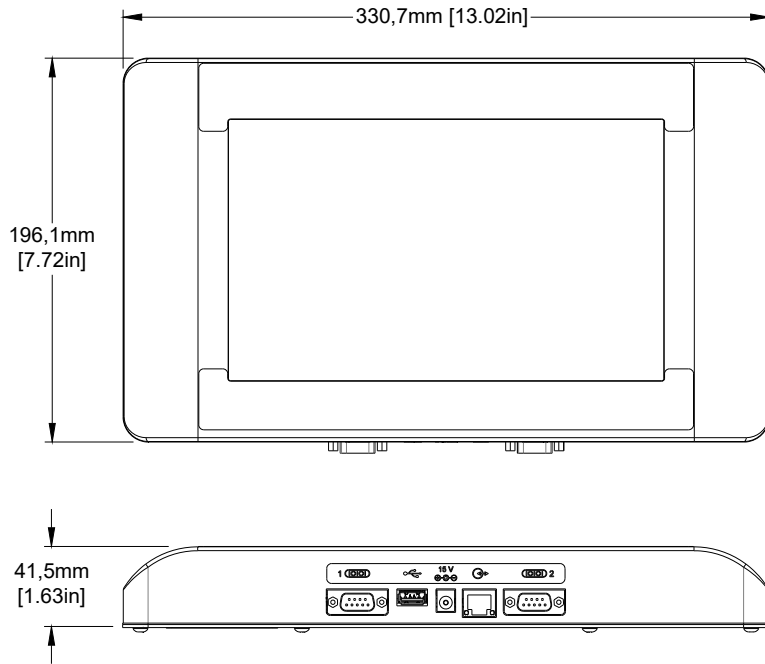
Size
Weight: 2,18kg [4.6lb]

Height: 196,1mm [7.72in]

Width: 330,7mm [13.02in]

Depth: 41,3mm [1.62in]

IP Rating
IP34 (estimated)

Enclosure
Stainless Steel

User Interface
Graphical User Interface with on screen keyboard

Fonts
Unicode

Display
259,08mm [10.2in] LCD with touch screen, 800 x 480 pixels

Storage
512 MB flash memory

Ports
(2) RS-232 ports, 1 USB port

(1) 100 Base-T Ethernet port

Electrical
Input: 15VDC, 4.6A

Environment
Ambient operating temperature: 5°C to 40°C (40°F to 104°F)

Operating humidity: 10% - 90%, non condensing

IJ4000 Impulse Jet

384E Print Head

Size - IJ384E Head
L: 300,8mm [11.84in]
W: 69,9mm [2.75in]
H: 127,0mm [5.0in]
Weight: 2,7kg [6 lbs]

IP Rating
IP65 (estimated)

Enclosure
Anodized aluminum, black

Electrical
24 VDC input from SMART-IDS

Ink Filtration
75 micron external vent filter

25 micron in-line system inlet filter

10 micron built-in filter in print engine

Print Speed
Alpha/Numeric Text: Up to 60,96 meters per minute [200 feet per minute] @ 200 dpi; 38,1 meters per minute [125 feet per minute] @ 300 dpi.

Barcode: Up to 45.72 meters per minute [150 feet per minute].

* Higher line speeds achievable with reduction of dpi.

Print Resolution
384/128 Head: 128 addressable channels, 50,8mm [2in] solid print height

Throw Distance
Up to 6mm [1/4in] for alphanumeric. 1,6mm [1/16in] recommended for best barcode quality.

280,3mm [11.04in]

116,8mm [4.60in]

66,5mm [2.62in]

22,9mm [0.90in]

146,8mm [5.78in]
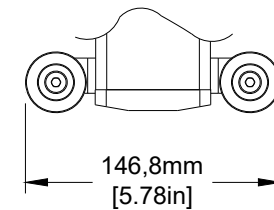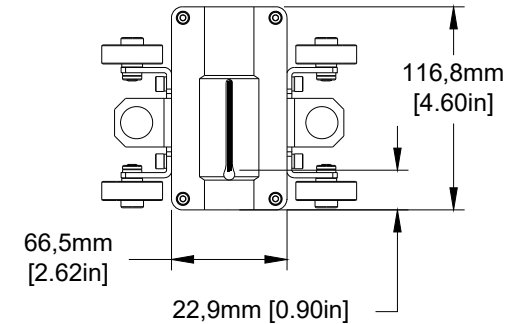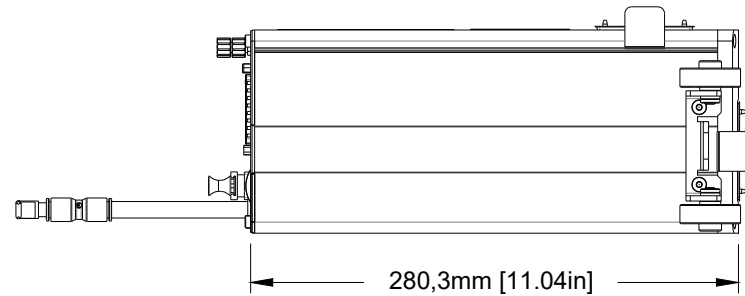
Ink Type
ScanTrue® II and ScanTrue® II PLUS, Pigmented Ink for porous substrates, black

Environment
Ambient operating temperature: 10°C to 40°C (50°F to 104°F)

Operating humidity: 5 - 80% non-condensing

ACS (Automatic Cleaning System) Consumable usage
ScanTrue II Ink: .38mL

768E Print Head

Size - IJ768E Head
L: 338,1mm [13.31in]
W: 71,1mm [2.80in]
H: 160,8mm [6.33in]
Weight: 4,3kg [9.5 lbs]

IP Rating
IP54 (estimated)

Enclosure
Anodized aluminum, black

Electrical
24 VDC input from SMART-IDS

Ink Filtration
75 micron external vent filter

25 micron in-line system inlet filter

10 micron built-in filter in print engine

151,9mm [5.98in]

160,8mm [6.33in]

27,1mm [1.07in]
TO LOWEST ORIFICE

338,8mm [13.34in]

Print Speed
Alpha/Numeric Text: Up to 60,96 meters per minute [200 feet per minute] @ 200 dpi; 38,1 meters per minute [125 feet per minute] @ 300 dpi.

Barcode: Up to 45.72 meters per minute [150 feet per minute].

* Higher line speeds achievable with reduction of dpi.

Print Resolution
768E/256 Head: 256 addressable channels, 101,6mm [4in] solid print height

Throw Distance
Up to 6mm [1/4in] for alphanumeric. 1,6mm [1/16in] recommended for best barcode quality.

Ink Type
ScanTrue® II and ScanTrue® II PLUS, Pigmented Ink for porous substrates, black

Environment
Ambient operating temperature: 10°C to 40°C (50°F to 104°F)

Operating humidity: 5 - 80% non-condensing

ACS (Automatic Cleaning System) Consumable usage
ScanTrue II Ink: .58mL

IJ4000 Impulse Jet

System Interconnect Diagram

1. IJ4000-HMI Controller
2. SMART-IDS
3. Print Head
4. Conveyor
5. Product
6. Print Head Bracketry
7. Ink Status Beacon
8. Encoder
9. Ink Supply
10. Photosensor
11. Vacuum Waste Collector Bottle
12. Encoder Cable
13. Print Head Cable
14. Throw Distance (3mm [1/8in] Recommended)

Customer System Connections

HMI

OR

NETWORK HUB

OR

CUSTOMER NETWORK

(Command & Control)

HANDHELD SCANNER (Message Lookup)

INTEGRATED SCANNER

WEIGHT SCALE

PLC

(External Input)

THERMAL TRANSFER PRINTER

TJ/HP PRINTER

IV12 VALVEJET PRINTER

POWER CORD

PRINT HEAD CABLES

I/O CABLE FROM SMART-IDS

PHOTOSENSOR / ENCODER CABLE

OPTIONAL I/O BOARD

TASK 2 INTERFACE BOARD CONNECTIONS

TASK 1 INTERFACE BOARD CONNECTIONS

ENCODER / PHOTOSENSOR CABLE

COM1 *

ETHERNET / HMI *

USB / FILE BACKUP & TRANSFER ACCESS

COM2 *

* CUSTOMER SYSTEM CONNECTIONS

Appendix B: Theory of Operation

Functional Description

The IJ4000 ink jet system prints text, autocodes (such as product counts or time and date stamps), barcodes, and/or graphics onto products as they travel by conveyor past stationary print heads. Print can be on any one of, or a combination of, the product's sides. The conveyor speed is monitored using a variable speed encoder or a built-in fixed speed encoder. Products are detected using a photosensor. The information to be printed is defined as a message and is programmed into the controller via a user interface.

Impulse Jet 384E and 768E Print Heads

The IJ4000 Impulse Jet print head assembly consists of a piezoelectric impulse jet print engine, a small ink reservoir, intake, purge, and return solenoid valves, and an electronic controller board to control both printing and fluidic management functions of the print head.

The piezoelectric impulse jet print engine has a nozzle plate with an array of orifices and a corresponding array of piezoelectric crystals. Piezoelectric crystals expand and contract rapidly based on voltage being supplied to and removed from crystals. Very small ink droplets are ejected as a result of piezoelectric crystals expanding rapidly, creating a pressure pulse to force ink droplets out the orifices. The print engine also incorporates a heater to control the head temperature, allowing ink viscosity to be maintained over a wide spread of ambient temperatures. The head must be at the correct operating temperature before printing. The head temperature can be monitored via the LEDs located on the back of the print head. LEDs are provided to show when the heater is on and when the head is at appropriate temperature.

The print head electronics receive power, as well as clock, data, and latch signals from the controller, to drive the heater and the imaging capabilities of the print engine. The print head electronics also control the ink management functions.

At the print head, ink flows in through the intake solenoid valve to fill a small print head reservoir. The ink level in the print head reservoir is maintained by a level detect, sensing the ink level and sending a signal to the SMART-IDS to turn on/off the ink pump. The reservoir is vented allowing atmospheric pressure to be maintained inside the reservoir. The vent is located on the back of the print head and is filtered to ensure debris can not enter the ink reservoir. Ink is fed from the print head ink reservoir to the print engine via gravity. Capillary action is then utilized to supply the orifices in the nozzle plate with ink.

NOTE: Since ink is fed to the print engine via gravity, it is important to maintain the print head at a level position during operation.

The print head also incorporates an Automatic Cleaning System (ACS) to remove dirt and debris from the orifice plate. A small vacuum channel has been designed into the bottom of the nozzle plate. During an ACS cycle, a small amount of ink is pulsed through the orifices. The ACS cycle turns the vacuum pump on in the SMART-IDS, and pulses both the ink pump and purge solenoid to control the flow of ink out the nozzle plate. The ink and debris is vacuumed off the nozzle plate, and drawn back to the waste collection bottle located in the SMART-IDS. An ACS cycle can be manually initiated by pushing the **ACS/Prime** button located on the back of the print head. The ACS can also be programmed to run at specified times by using the IJ4000-HMI Controller.

When print head priming is required, the ink is pumped directly into the print engine, through the purge solenoid, and out through the return solenoid valve, allowing air to be pushed out of the head. This is required only during initial set-up and when the print engine has been replaced. The ink is returned and collected in the SMART-IDS waste collection bottle. This function can be initiated by pushing in and holding the **ACS/Prime** button located on the back of the head for 5 seconds.

Another function is the ability to check for 100% print from the print head. This function can be performed by momentarily pressing the **All Channel Print** button on the rear of the print head while passing a substrate in front of it in a horizontal direction.

A digital level indication is provided by three LEDs located on the top rear of the enclosure. The print head is considered level, as indicated by a central green LED, when it is within +/- 1.5° front-to-back, level to the horizon. The digital level is factory calibrated to within 0.2° absolute.

The print head is sealed at many points to protect against liquid ingress that could damage internal components.

Print Head Daisy Chain

Print heads attach to the IJ4000 in a daisy chain configuration. The first print head plugs into a Print Head Interface Board (P1), and the second print head plugs into the first print head. The maximum number of print heads for a 384E daisy chain is two. An IJ4000-HMI Controller can have one or two daisy chains (one for each Print Head Interface Board).

Electrically, a print head daisy chain is a shift register. A shift register moves bits of information along a line one bit at a time in step with a clocking signal. It works like this: A bit is placed at the entrance to the line of bits and waits for the clock (step) signal. When the clock signal is given, the bit steps into the first spot on the line. The bit that occupied the first spot in line steps to the second, the second steps to the third, the third to the fourth, and so on until the last bit in line steps off the end of the line and is lost. Repeat the process enough times and all of the information in the shift register is replaced. Repeat the process for all dots in the column. A latch (print) signal sent after the dots have been shifted prints the column.

All daisy chain signals - DATA, CLOCK and LATCH - are generated and controlled by circuitry in the FPGA (Field Programmable Gate Array, used as a print head driver chip) on the Print Head Interface Board.

Please note that power is applied to the print heads even when the IJ4000 is "turned off." The only way to remove power from the print heads is to pull the plug.

Print Trigger Photosensor

The photosensor detects when a product is about to pass by the print heads and signals the IJ4000-HMI Controller to start a print cycle. The photosensor signal is active low, and it must remain low for at least one encoder pulse. Once a print cycle starts, it continues to completion regardless of what the photosensor signal does.

The IJ4000 is compatible with through-beam, retro-reflective, and diffused photosensors that work at 24VDC and have a current sinking (or open collector) output. The photosensor plugs into the Print Head Interface Board (P2).

Encoder

The encoder determines the time period between the printing of individual columns, or the print speed. As a product's speed increases, the time period between columns must decrease, that is, the print speed must increase, to maintain consistent column-to-column spacing. The IJ4000 has two encoder options, external and internal. Use the external encoder when the conveyor speed fluctuates. Use the internal encoder when the conveyor speed is constant.

The **external encoder** is a 24VDC optical encoder. The encoder's wheel is sized such that the encoder outputs 300 pulses per inch of product travel. The external encoder plugs into the Print Head Interface Board (J4), and its signal goes to the FPGA where it is used to time the sending of column data to the print head.

The **internal encoder** signal is a constant frequency pulse stream generated on the Print Head Interface Board. A programmable counter circuit in the FPGA divides the board's 32 MHz clock by a value calculated from a line speed entered during system setup. When the user selects the internal encoder, a switch in the FPGA disconnects the external encoder signal from the print timing circuits and connects the output from the counter circuit.

SMART-IDS (Ink Delivery System)

System Features

1. *SMART-IDS.* Ink is pumped from one location through a single tubing line that is subsequently teed downstream to all print heads in the system. As the print heads demand more ink, the liquid pump delivers ink to the requesting print head. Although the ink line is pressurized, a print head will not receive the ink unless its intake solenoid is opened. Each print head controls its own ink level in its own reservoir.

2. *Ink supply "low" detection.* When the SMART-IDS detects ink low via the float in the ink reservoir, it disables the ink pump, leaving a safe amount of ink. The SMART-IDS then alerts the operator by turning on the attached beacon light, and by sending a signal via I/O to the IJ4000-HMI Controller.

3. *Ink supply "out" detection.* If the ink supply bottle is not replaced in a timely fashion, the next time that a print head requests ink, a timer in the print head will start. If the ink supply has not been replaced within five minutes, print will be disabled on all print heads, and a signal will be sent to the SMART-IDS that will cause a slow flashing of the beacon.

4. *SMART-IDS vacuum and ink waste collector*. Like the ink, vacuum is supplied to all the print heads via a single tubing line that is subsequently teed. The SMART-IDS is equipped standard with a heavy-duty vacuum pump to assist in the Automatic Cleaning System (ACS). Additionally, it will assist in the removal of waste ink while bleeding the tubing.

5. *Ink capacity.* Both the 500 mL and 1 L bottles are accommodated by the SMART-IDS.

6. *Safety.* The on-board microcontroller will prevent an excessive duty cycle on the liquid pump. It also disables the liquid pump when ink is low, and both pumps when any ink anomaly is encountered such as ink out or ink faults.

Startup Operation

After all plumbing and electrical connections have been made, toggling the power switch will initiate the SMART-IDS. The system only responds to input from the I/O connection to the IJ4000. This I/O connection is essentially a pass through connection to the print head bus. In other words, the print heads control the ink pump and vacuum pump on/off states. If the print heads are not requesting ink for reservoir refill or vacuum from an ACS cycle, then the SMART-IDS will remain idle.

Normal Operation

The ink bottle supplies the open-vented reservoir. The reservoir creates the first of three stages of ink filtration. When the print head demands ink from the SMART-IDS, the ink pump turns on. The ink is pulled through the reservoir filter through a check valve and into the pump. As the ink is pulled from the reservoir, a vacuum is created in the bottle. To equalize this pressure differential, air is pulled through the vent into the reservoir.

The pump will then push the ink to the print head that is requesting ink until the float in the print head reservoir is satisfied. Each print head controls its own ink level by opening and closing an intake solenoid. The SMART-IDS operates in this state until it encounters a different ink status.

If the SMART-IDS includes the pressurized solvent supply, the print head will open and close an internal solenoid to allow flow of solvent down the face of the print head. As with ink and vacuum, a separate tubing line is required from the SMART-IDS. A pressurized can of solvent is the main source of solvent. The solvent flows through a regulator into the SMART-IDS. This supply line has a pressure sensor to detect when the pressurized solvent can is empty. When the can is empty, the beacon light will illuminate steady. One must determine the state of the beacon lamp by determining whether the ink supply is visually empty or the solvent can is empty, and then replace the appropriate material.

Ink Low Detection

When the ink bottle empties into the ink reservoir, a float will drop in the reservoir. After the float drops in the reservoir, the microcontroller will disable the liquid pump and turn on the beacon steady. This alerts the operator that it is time to replace the ink bottle. When the ink bottle has been replaced, the SMART-IDS will automatically extinguish the beacon light.

NOTE: The ink pump is disabled in order to inhibit an ink / air-bubble mixture from getting into the impulse jet print engines.
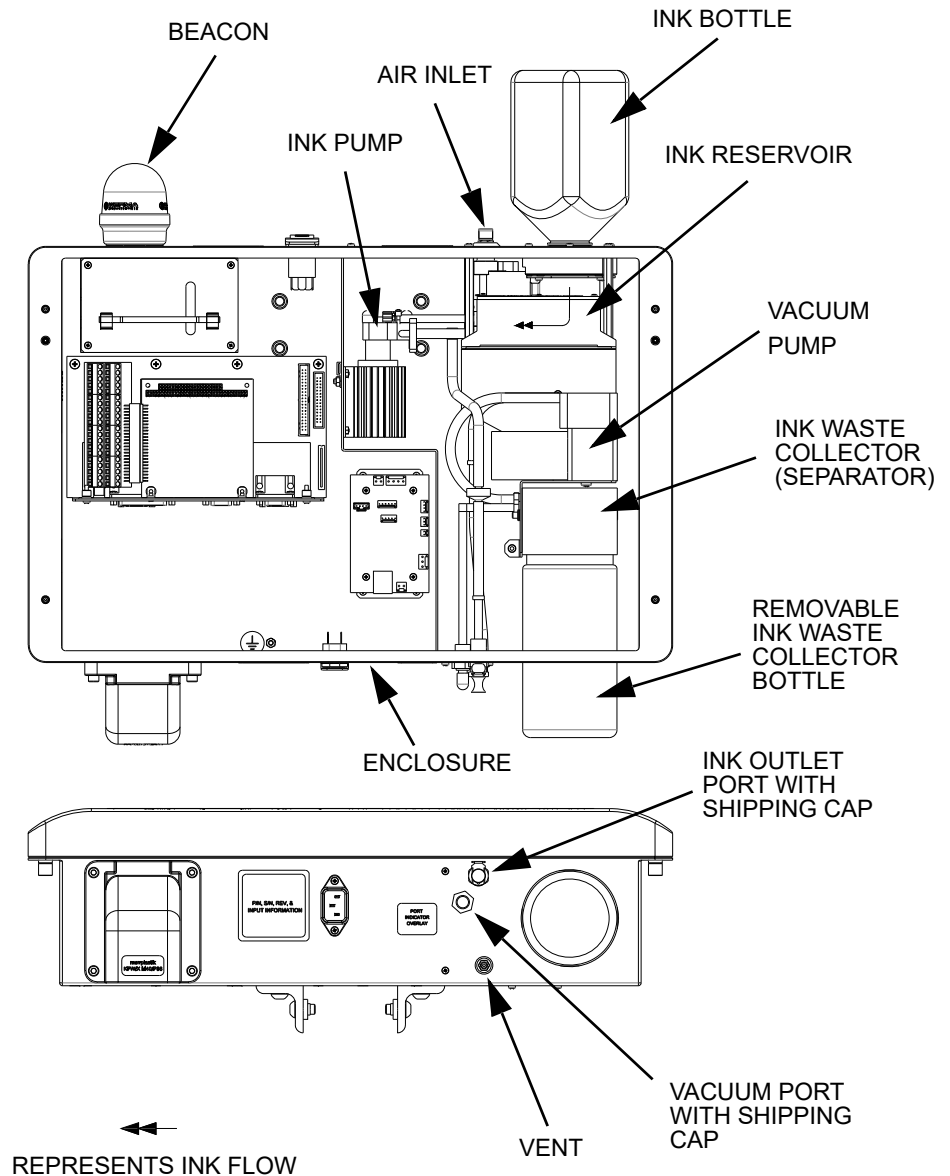
REPRESENTS INK FLOW

NOTE: DOOR NOT SHOWN.

Ink Out Detection

If the steady beacon light is ignored and a print head requests ink, a timer is started in the print head microcontroller. If the ink bottle is not replaced within five minutes, then the beacon changes to a slow flash. In addition, print is disabled on all print heads on both IJ4000 tasks.

Ink Waste Collector Full

Upon filling the ink waste collector (separator) bottle, a float level detect raises inside the separator assembly. The feature disables both pumps inside the SMART-IDS and illuminates the beacon with a fast flash. By disabling the pumps, overflow is not only prevented at the separator bottle, but also at the print head by disabling the ACS feature. Additionally, the vacuum pump is prevented from pulling the ink into itself.

Once the ink separator bottle has been replaced or emptied, the SMART-IDS power switch must be toggled off then on to reset.

Ink Fault Detection

If an ink line is not plugged into a port or is broken, the pump will turn on for a maximum of ten seconds and then shut itself off if the print head float sensor has signalled for shut off. After the pump cycle, the beacon will flash quickly. Functionality will emulate Ink Waste Collector Full.

Once the ink fault has been remedied, the SMART-IDS power switch must be toggled off then on to reset.
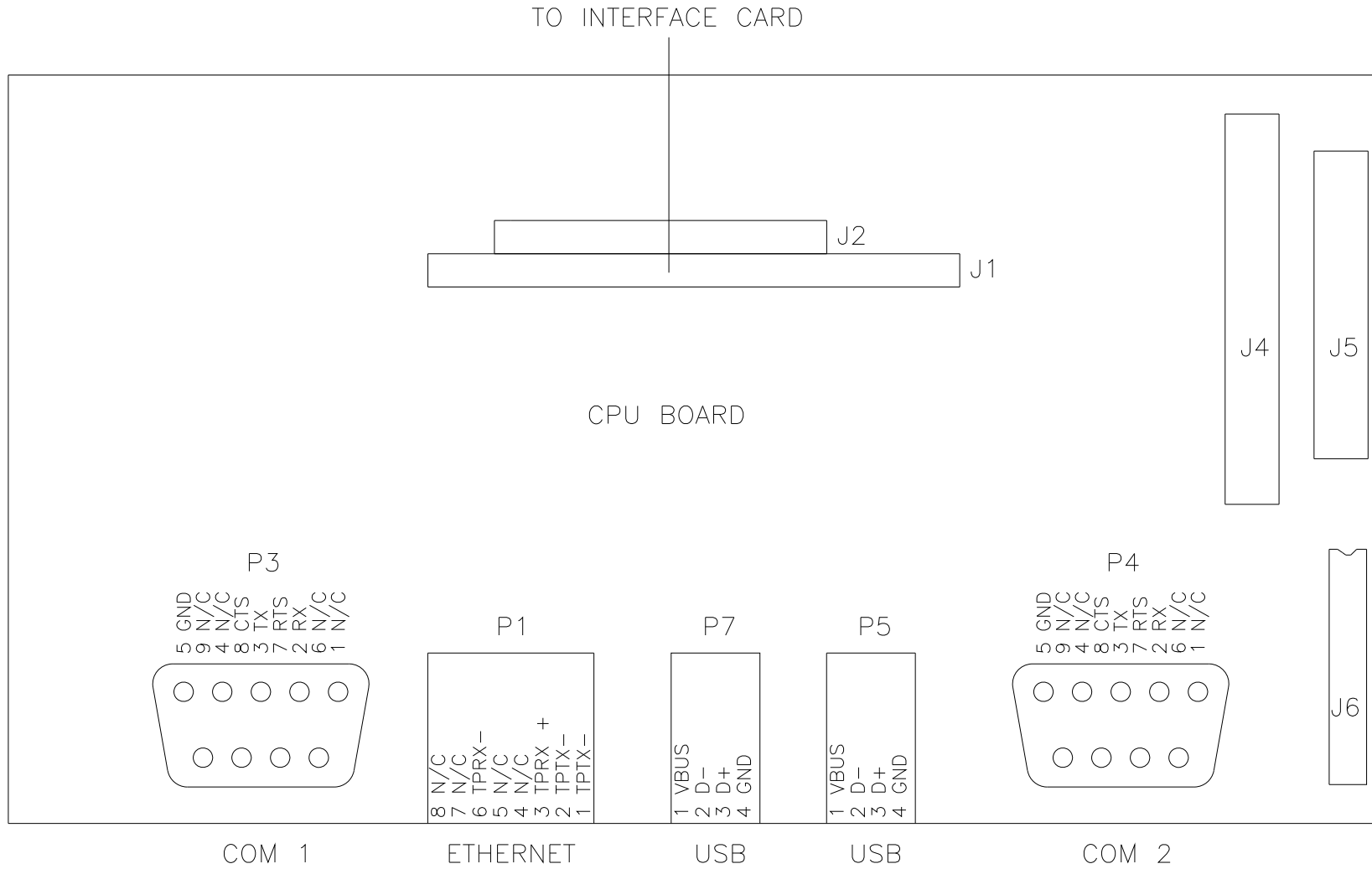
NOTE: Never mix ink types because they are not miscible. Irreversible internal damage will occur.
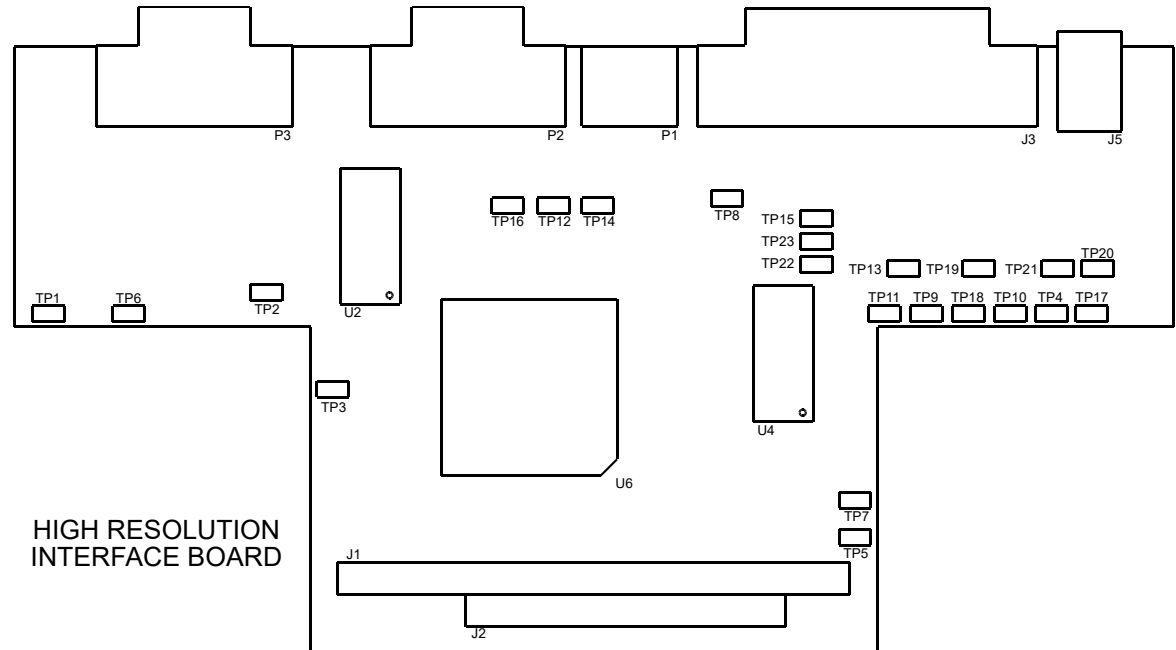
IJ4000 SMART-IDS Main CPU PCB
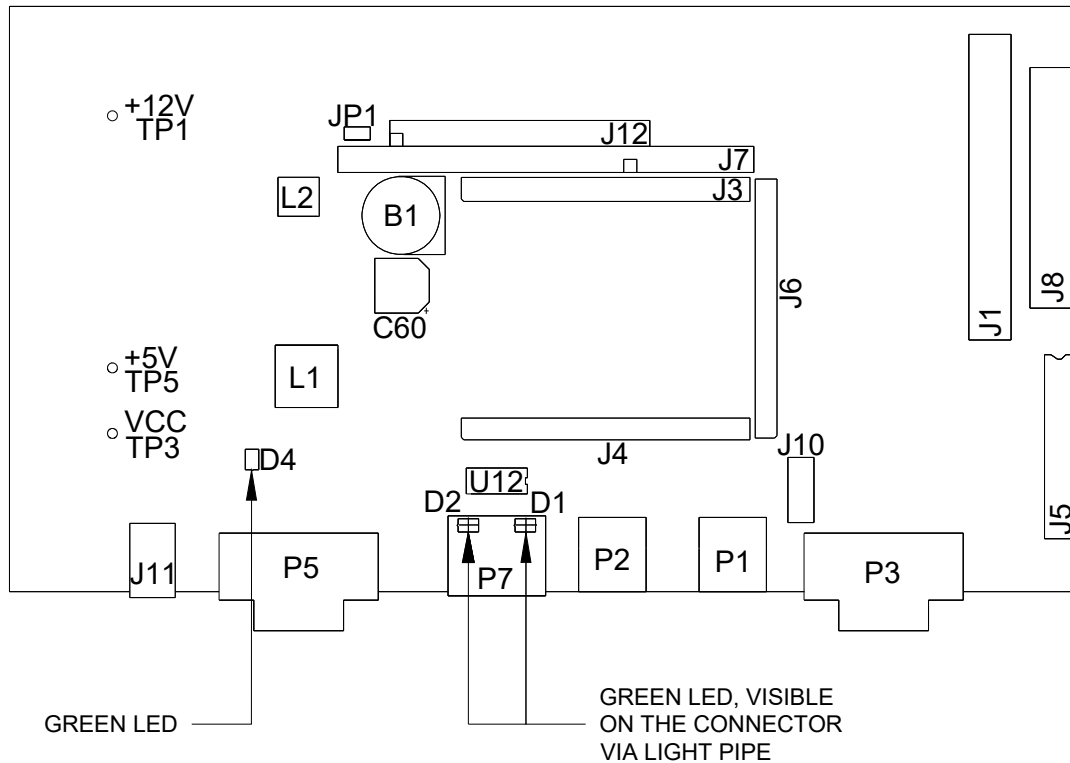
Test Points: TP1: 12VDC, power for display backlight. Turns on/off with soft powerswitch.

TP2: 5VDC, power for 5V logic. Also supplies the input voltage to the 3.3V regulator.

TP3: 3.3VDC, power for 3.3V logic. Also supplies the input voltage to the 1.8V regulator.

TP4: 1.8VDC, power for the CPU core.

LEDs: D1: Ethernet connector, Green. Flashes to indicate network traffic.

D2: Ethernet connector, Green. Indicates valid network connection.

D1: Yellow, flashes when the CPU is running.(On CPU module)

D4: Green, indicates 3.3V is present.

D2: Green, indicates 3.3V is present. (On CPU module)

IJ4000 SMART-IDS Main CPU PCB (continued)

TO INTERFACE CARD

J2

J1

CPU BOARD

J4   J5

J6

P3
5 GND
9 N/C
4 N/C
8 CTS
3 TX
7 RTS
2 RX
6 N/C
1 N/C

P1
8 N/C
7 N/C
6 TPRX-
5 N/C
4 N/C
3 TPRX +
2 TPTX-
1 TPTX-

P7
1 VBUS
2 D-
3 D+
4 GND

P5
1 VBUS
2 D-
3 D+
4 GND

P4
5 GND
9 N/C
4 N/C
8 CTS
3 TX
7 RTS
2 RX
6 N/C
1 N/C

COM 1   ETHERNET   USB   USB   COM 2
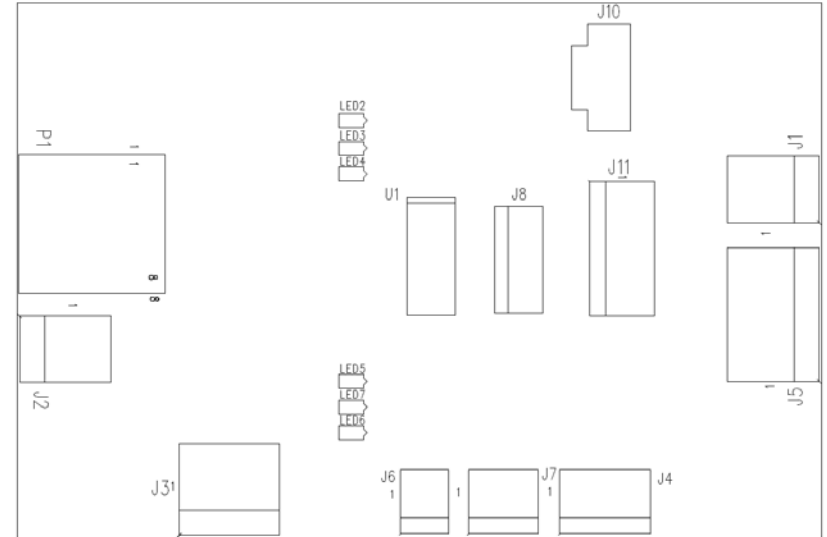
IJ4000 Print Head Interface PCB

HIGH RESOLUTION
INTERFACE BOARD

Test Points:
TP1: 5VDC.
TP2: 3.3VDC.
TP3: 2.5VDC.
TP4: GND.
TP5: (FPGA) PROGRAM; pulses low to initiate FPGA programming.
TP6: (FPGA) INIT; goes LOW to indicate an FPGA programming error.
TP7: (FPGA) DONE. LOW when the FPGA is being programmed. High when FPGA programming is complete.
TP8: SMART-IDS error signal, active low.
TP9: Print head vacuum signal, active high.
TP10: SMART-IDS ink low signal, active low.
TP11: Print head pump signal, active high.
TP12: SMART-IDS ink out signal, active low.
TP13: Print head at temperature signal, active low.
TP14: SMART-IDS vacuum signal, active low.
TP15: Print head ink out signal, active high.
TP16: SMART-IDS pump signal, active low.
TP17: DC power in (24V).
TP18: Print head CLOCK signal.
TP19: Print head DATA2 signal.
TP20: Print head DATA signal.
TP21: Print head LATCH signal.
TP22: PHOTOSENSOR signal, active high.
TP23: External ENCODER signal.
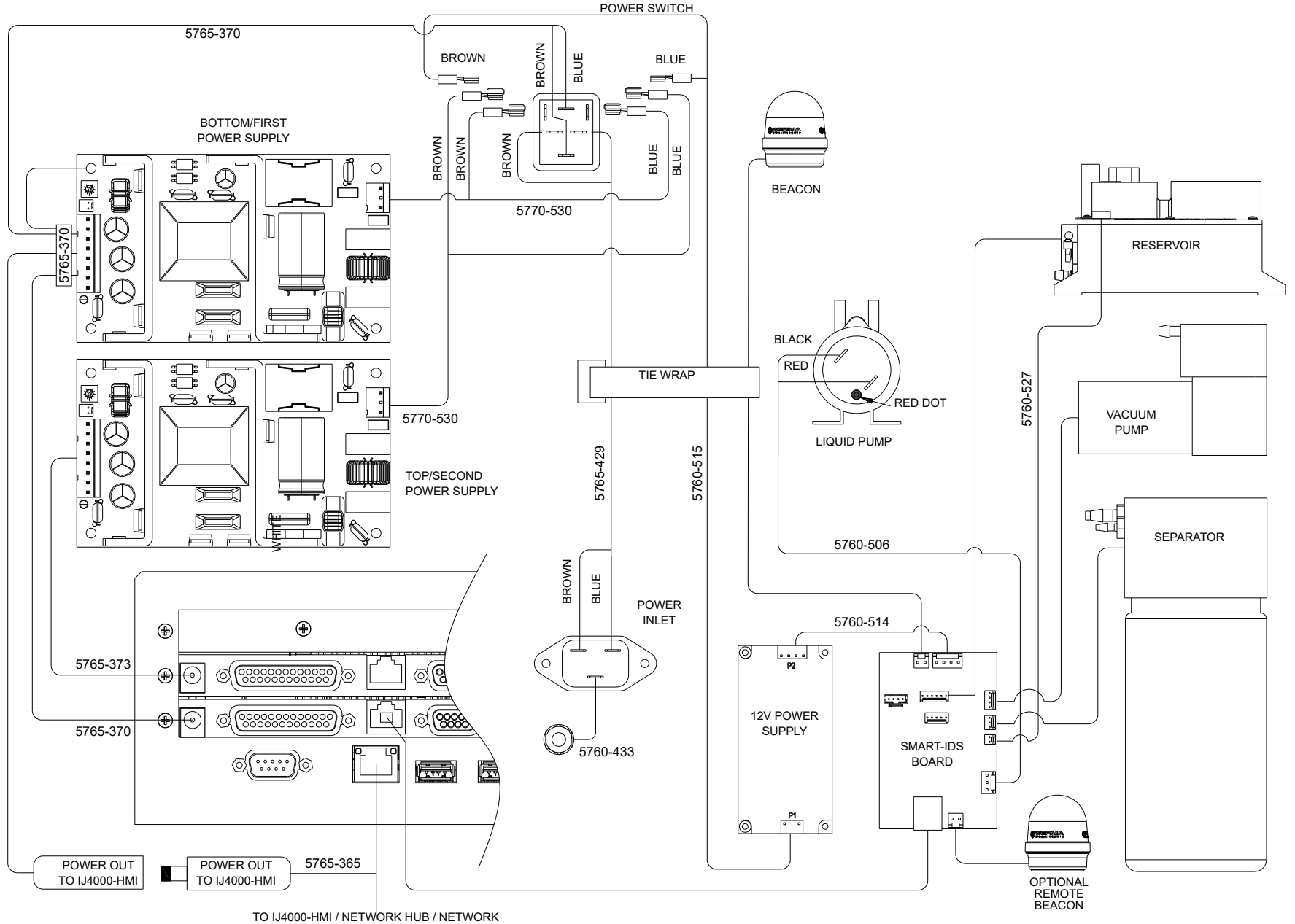
IJ4000 Print Head Interface Interconnect Diagram
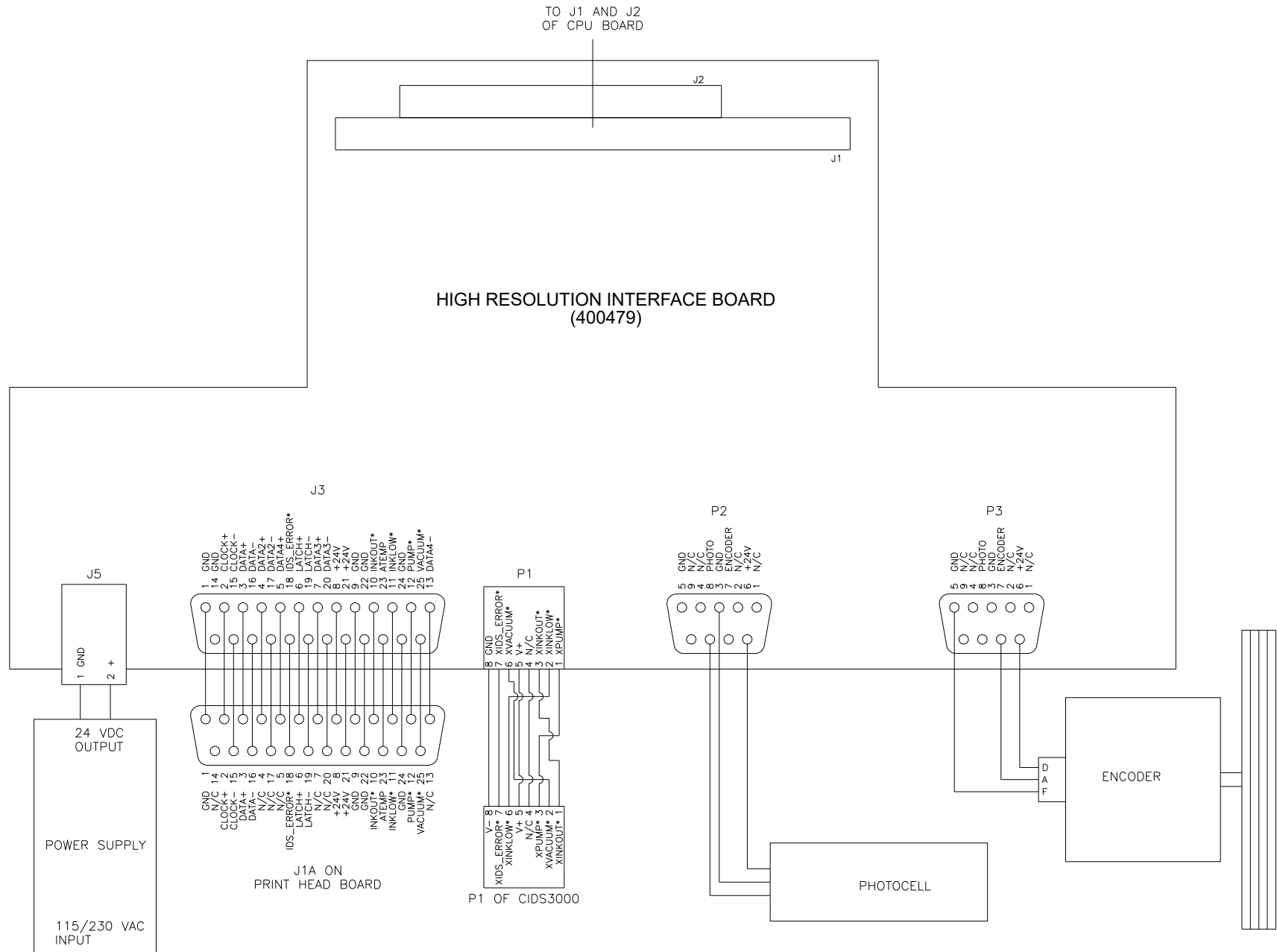
SMART-IDS Ink and Vacuum Control PCB

LEDs:

LED1:   NOT DEFINED.

LED2:   Red; indicates a print head is signaling that the print head reservoir is low and the ink out timer has expired.

LED3:   Green; indicates a print head is signaling for the vacuum pump to turn on.

LED4:   Green; indicates a print head is signaling for the liquid pump to turn on.

LED5:   Red; indicates that the waste bottle is full.

LED6:   Red; turns on, off, and flashes with the beacon. Off indicates ink is OK, on indicates ink is low, slow flash (1 Hz) indicates ink is out, and fast flash (6 Hz) indicates that the waste bottle is full or the pump was turned on for more than 10 seconds.

LED7:   Yellow; indicates ink is low in the SMART-IDS reservoir.

Connectors:

SW1:   NOT DEFINED.

P1:   SMART-IDS I/O connector.

J1:   Beacon.

J2:   External beacon.

J3:   Liquid pump.

J4:   Vacuum pump.

J5:   Power (12V).

J6:   Reservoir float switch.

J7:   Waste bottle float switch.

J8:   Programming port, for programming U1 via a PC.

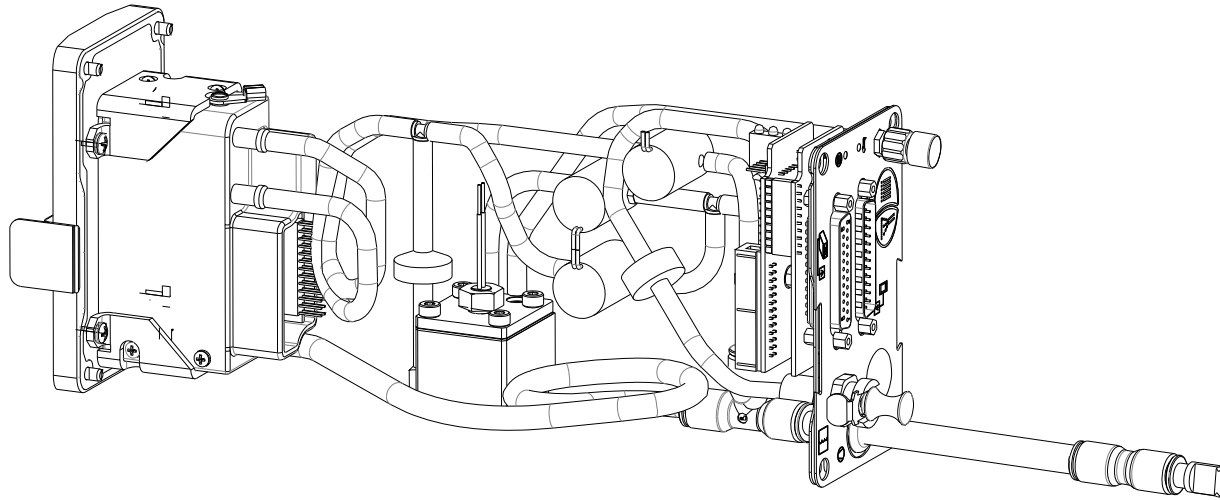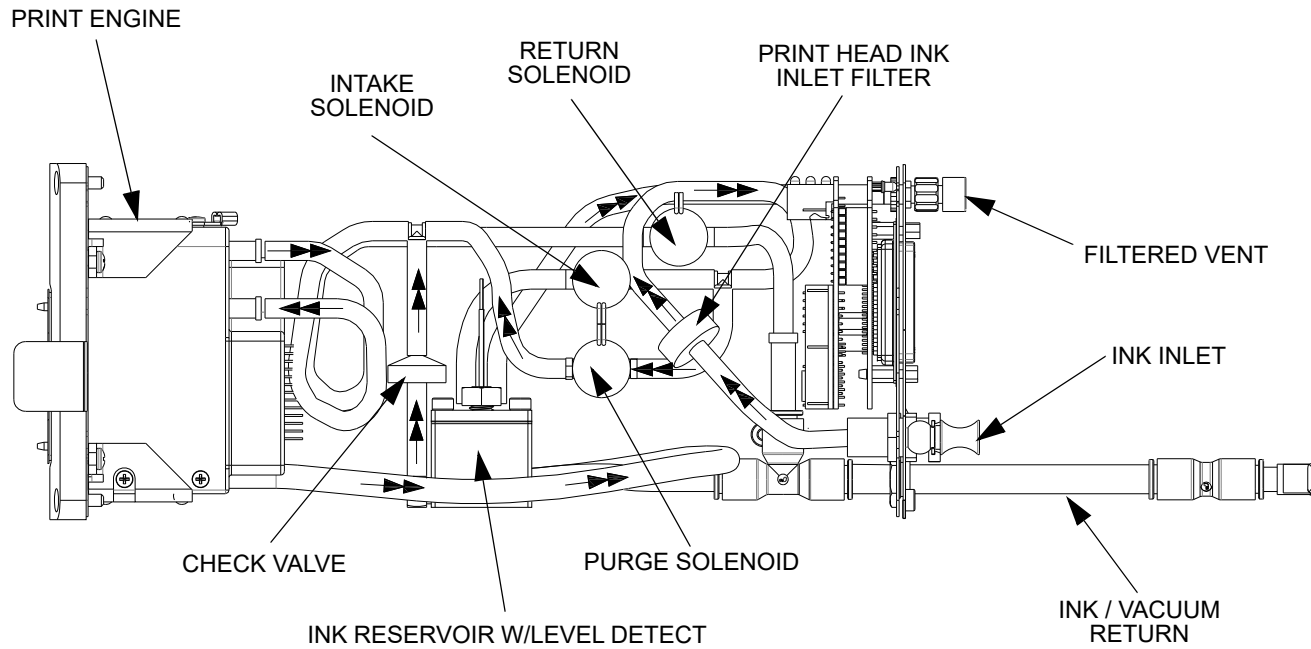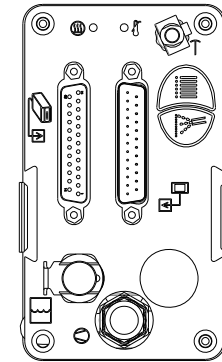J10:   Pressure sensor for flushing solvent

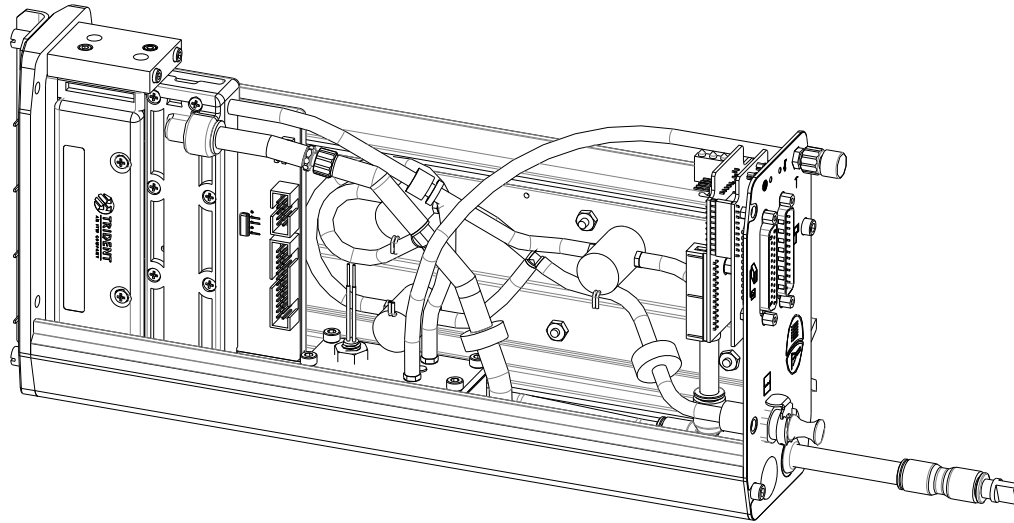J11:   RFID communication
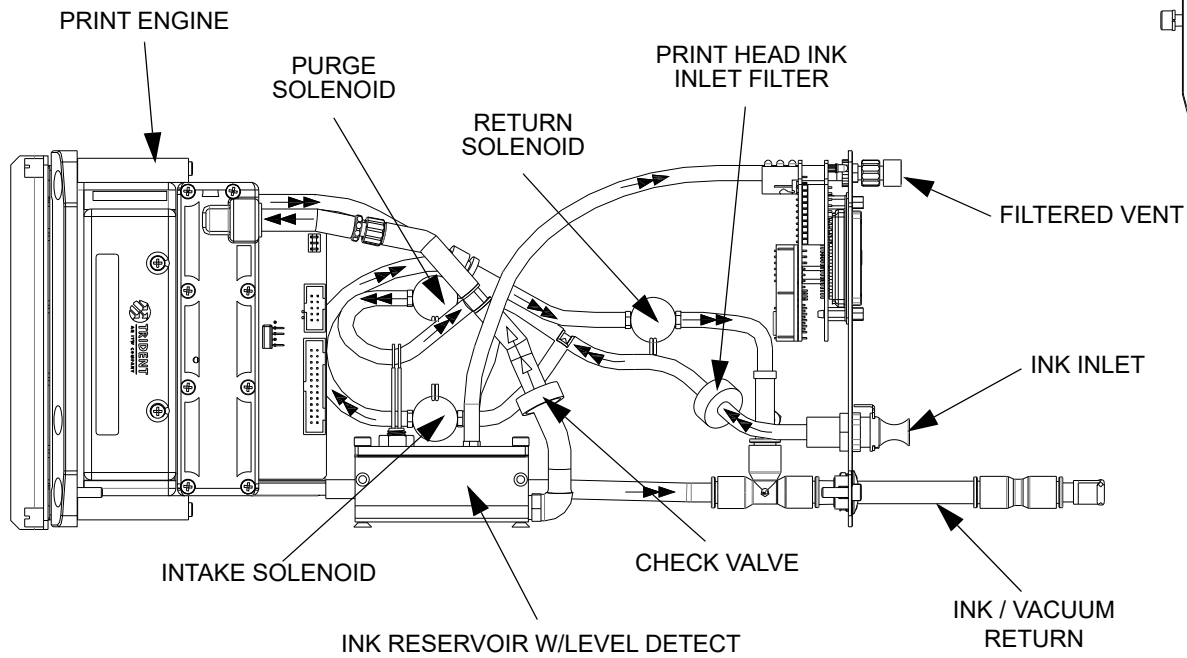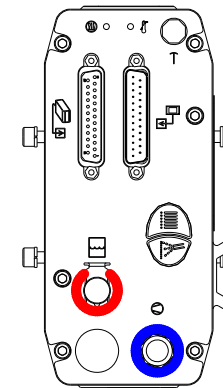
SMART-IDS Internal Wiring Diagram

IJ384E Print Head

PRINT ENGINE

INTAKE
SOLENOID

RETURN
SOLENOID

PRINT HEAD INK
INLET FILTER

REAR VIEW

FILTERED VENT

INK INLET

CHECK VALVE

PURGE SOLENOID

INK / VACUUM
RETURN

INK RESERVOIR W/LEVEL DETECT

IJ768E Print Head

REAR VIEW

PRINT ENGINE

PURGE SOLENOID

RETURN SOLENOID

PRINT HEAD INK INLET FILTER

FILTERED VENT

INK INLET

INTAKE SOLENOID

CHECK VALVE

INK RESERVOIR W/LEVEL DETECT

INK / VACUUM RETURN

Print Head Control PCB
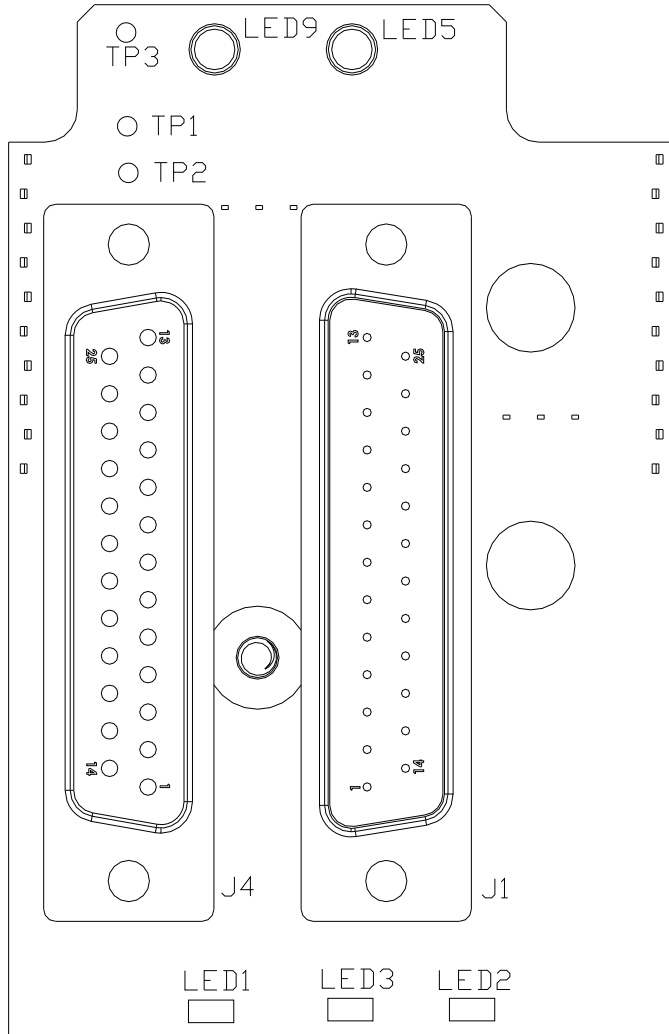
5765-543
PRINT HEAD PCB
(FRONT VIEW)

5765-543
PRINT HEAD PCB
(BACK VIEW)

IJ4000 Impulse Jet

B: Theory of Operation
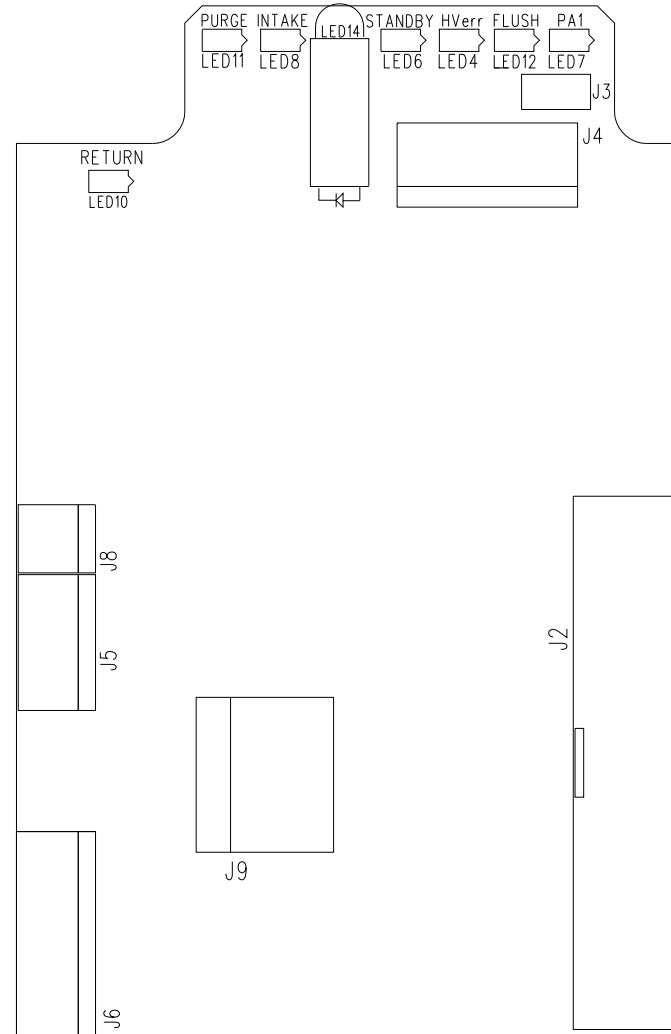
Print Head

Test Points:

TP1:   LATCH; 5 volt logic signal. The column is printed on the rising edge of the LATCH signal.

TP2:   CLOCK; 5 volt logic signal. Data is shifted into the shift register on the falling edge of the CLOCK signal.

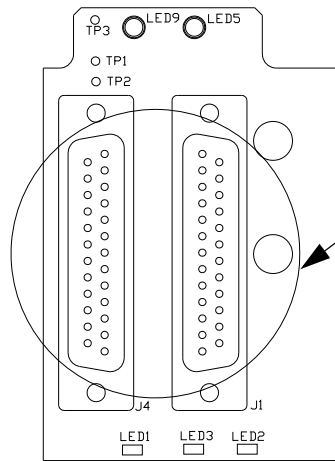TP3:   DATA; 5 volt logic signal. Serial data input signal to shift register.

LEDs:

LED1:   Green; indicates print head is requesting SMART-IDS to turn liquid pump on.

LED2:   Green; indicates print head is requesting SMART-IDS to turn vacuum pump on.

LED3:   Green; indicates print head reservoir is low and the ink out timer has expired.

LED4:   Green; indicates high voltage is low.

LED5:   Green; indicates print head has reached its operating temperature. The operating temperature is set via a resistor in the print engine.

LED6:   Green; indicates print head is in stand-by mode. Heater and high voltage are turned off.

LED7:   Green; indicates print head reservoir is full.

LED8:   Green; indicates intake valve is open.

LED9:   Yellow; indicates heater is on.

LED10: Green; indicates return valve is open.

LED11: Green; indicates purge valve is open

LED12: (Not used.)

LED14: Print head level indicators, Red-Green-Red.

Connectors:
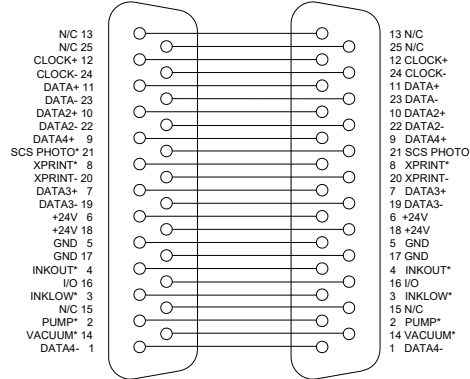
J1:   Print head I/O connector.

J2:   Print engine connector.

J4:   Print head I/O connector (5765-560 board).

J4:   Programming port, for programming microcontroller via a PC (5765-543 board).

J5:   Reservoir float switch connector.

J6:   Solenoid valve assembly connector.

J8:   (Not used.)

5765-018 Operations Manual Rev J   Page 69

Print Head Interconnect Diagram

5765-543 PRINT HEAD PCB (FRONT VIEW)

TP3 LED9 LED5
TP1
TP2
SEE IMAGES AT RIGHT
J4   J1
LED1 LED3 LED2

J3 ON IJ INTERFACE BOARD / **J1 PRINT HEAD BOARD**

N/C 13	13 N/C
N/C 25	25 N/C
CLOCK+ 12	12 CLOCK+
CLOCK- 24	24 CLOCK-
DATA+ 11	11 DATA+
DATA- 23	23 DATA-
DATA2+ 10	10 DATA2+
DATA2- 22	22 DATA2-
DATA4+ 9	9 DATA4+
SCS PHOTO* 21	21 SCS PHOTO*
XPRINT* 8	8 XPRINT*
XPRINT- 20	20 XPRINT-
DATA3+ 7	7 DATA3+
DATA3- 19	19 DATA3-
+24V 6	6 +24V
+24V 18	18 +24V
GND 5	5 GND
GND 17	17 GND
INKOUT* 4	4 INKOUT*
I/O 16	16 I/O
INKLOW* 3	3 INKLOW*
N/C 15	15 N/C
PUMP* 2	2 PUMP*
VACUUM* 14	14 VACUUM*
DATA4- 1	1 DATA4-
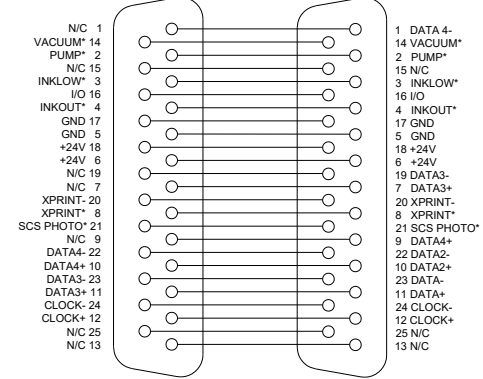
J4 PRINT HEAD BOARD / **J1 * PRINT HEAD BOARD (SECOND PRINT HEAD IN DAISY CHAIN)**

N/C 1	1 DATA 4-
VACUUM* 14	14 VACUUM*
PUMP* 2	2 PUMP*
N/C 15	15 N/C
INKLOW* 3	3 INKLOW*
I/O 16	16 I/O
INKOUT* 4	4 INKOUT*
GND 17	17 GND
GND 5	5 GND
+24V 18	18 +24V
+24V 6	6 +24V
N/C 19	19 DATA3-
N/C 7	7 DATA3+
XPRINT- 20	20 XPRINT-
XPRINT* 8	8 XPRINT*
SCS PHOTO* 21	21 SCS PHOTO*
N/C 9	9 DATA4+
DATA4- 22	22 DATA2-
DATA4+ 10	10 DATA2+
DATA3- 23	23 DATA-
DATA3+ 11	11 DATA+
CLOCK- 24	24 CLOCK-
CLOCK+ 12	12 CLOCK+
N/C 25	25 N/C
N/C 13	13 N/C

* J1 CONNECTOR SHOWN INVERTED FOR CLARITY

5765-543 PRINT HEAD PCB (BACK VIEW)

PURGE INTAKE STANDBY HVerr FLUSH PA1
LED11 LED8 LED4 LED6 LED4 LED12 LED7 J3
J4
RETURN
LED10

J8
| 4 DETECT |
| 3 +5V |
| 2 GND |
| 1 FLOAT |
J5
RESERVOIR
J9

| 6 RETURN |
| 5 +12V |
| 4 INTAKE |
| 3 +12V |
| 2 PURGE |
| 1 +12V |
J6

FLUSH/RETURN SOLENOID
INTAKE SOLENOID
PURGE SOLENOID

768E PRINT ENGINE

26 N/C	25 +90V
24 AUX	23 RXD
22 GND	21 TXD
20 ATEMP	19 N/C
18 GND	17 GND
16 HEATER	15 HEATER
14 +12V	13 +12V
12 PRINT-	11 PRINT+
10 LATCH-	9 LATCH+
8 DATA2-	7 DATA2+
6 DATA-	5 DATA+
4 CLOCK-	3 CLOCK+
2 GND	1 GND

J2
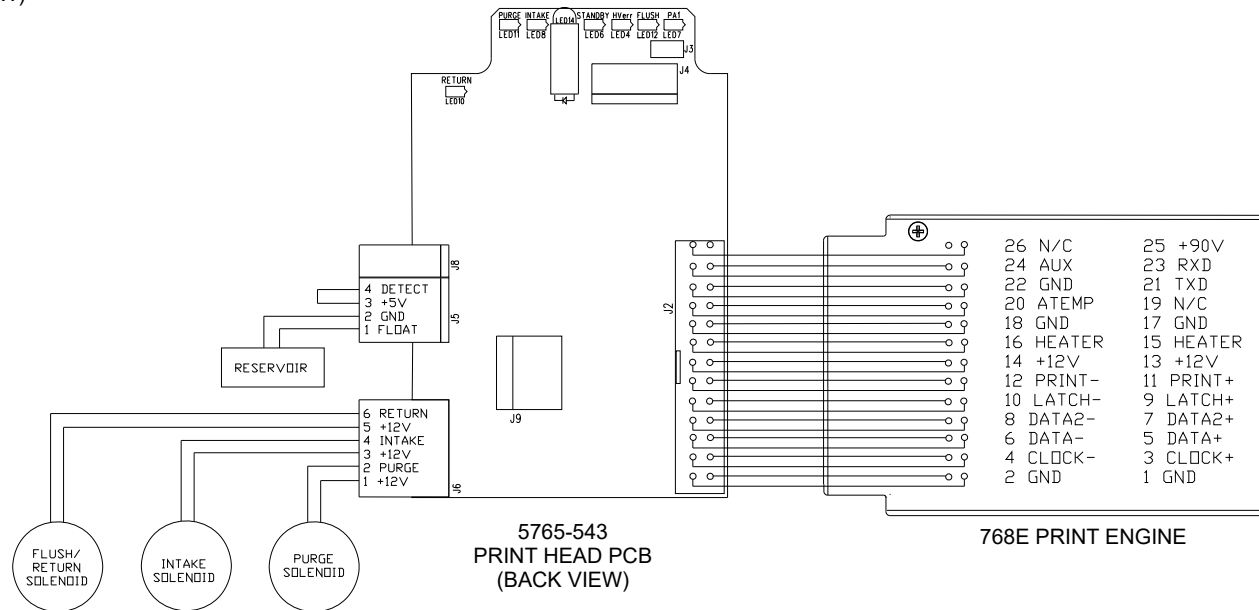
Appendix C: Updating the HMI & SMART-IDS via USB or Ethernet

For instructions on updating the controller and ink delivery system, please refer to document **5765-390N Updating the Controller and Ink Delivery System via USB or Ethernet**.

Appendix D: InkJet Demo Software for Windows

For information on the InkJet Demo software, please refer to document **5765-388N InkJet Demo Software for Windows**.

Appendix E: Software Interface

For information on interfacing with the software, please refer to document **5760-113 Software Interface Document**.

Appendix F: Part Numbers

System

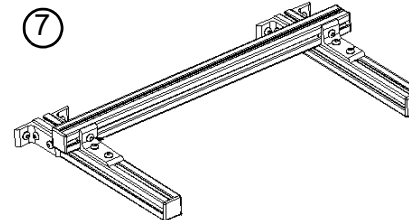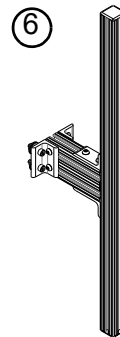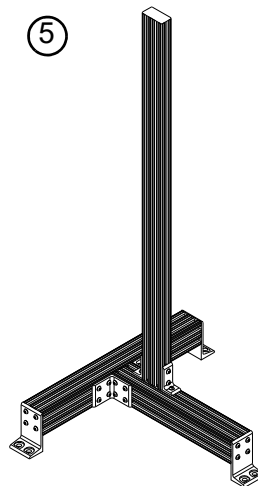| Item	Part No.	Description
1	5765-004J	IJ4000-HMI Controller, Stainless Enclosure, (Domestic or European)
2	5765-013384S2	IJ4000 384E Print Head, ScanTrue II® (Domestic or European)
	5765-013384S2FL	IJ4000 384E Print Head, ScanTrue II®, Flushed (Domestic or European)
3	5765-015768S2	IJ3000 768E Print Head, ScanTrue II® (Domestic or European)
4	5765017DJ1	IJ4000 SMART-IDS, 1 Card (Domestic)
	5765017DJ2	IJ4000 SMART-IDS, 2 Cards (Domestic)
	5765017DJ1-S	IJ4000 SMART-IDS, 1 Card, I/O (Domestic)
	5765017DJ2-S	IJ4000 SMART-IDS, 2 Cards, I/O (Domestic)
	5765017EJ1	IJ4000 SMART-IDS, 1 Card (European)
	5765017EJ2	IJ4000 SMART-IDS, 2 Cards (European)
	5765017EJ1-S	IJ4000 SMART-IDS, 1 Card, I/O (European)
	5765017EJ2-S	IJ4000 SMART-IDS, 2 Cards, I/O (European)
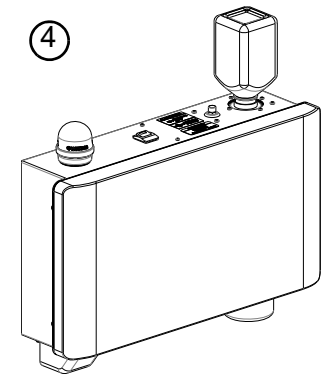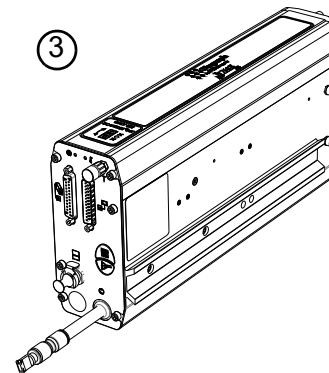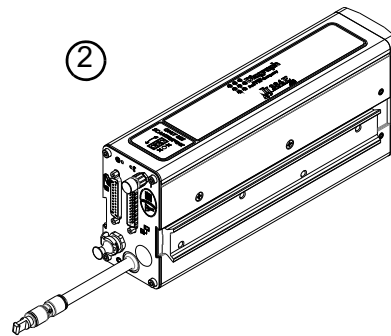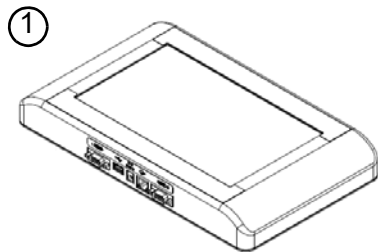
Bracketry

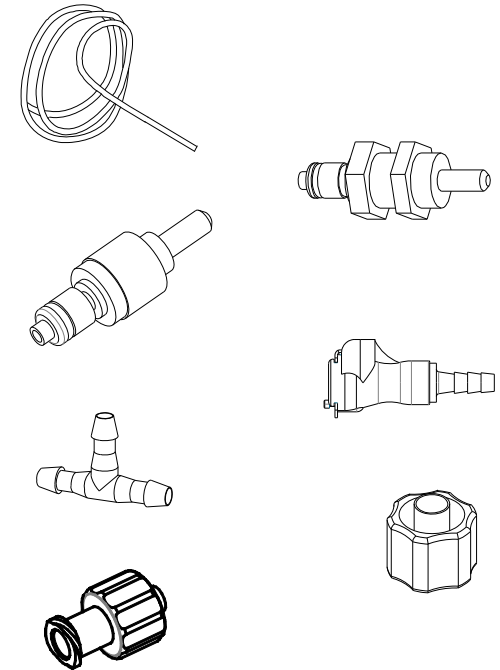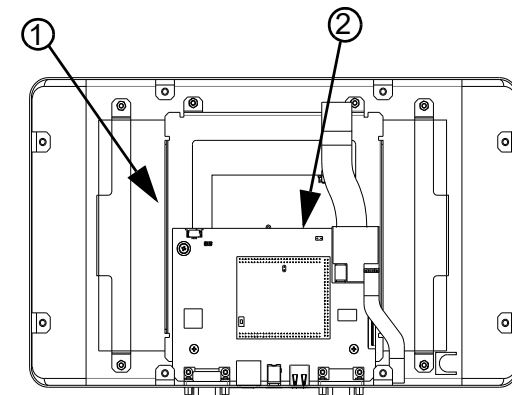| Item	Part No.	Description
1	5765-258	IJ4000 Print Head Roller/Retractor Mounting Bracket Kit, 384E Print Head (Domestic or European)
2	5765-243	Dovetail Adapter Kit, 384E Print Head (Domestic or European)
3	5780-253	IJ4000 Retracting Bracket Kit, 384E or 768E Print Head (Domestic or European)
4	5765-253	IJ4000 Print Head Roller Mounting Bracket Kit, 768E Print Head (Domestic or European)
5	5765-249	IJ4000 T-Base Stand Kit
6	5765-250	IJ4000 Conveyor Mounting Bracket Kit
7	5760-354	Multi Print Head Conveyor Mounting Kit *
8	5760-355	Print Head Floor Mounting Kit *
9	5760-356	Multi Print Head Floor Mounting Kit w/24" Bar *
	5760-357	Multi Print Head Floor Mounting Kit w/44" Bar *
* Requires Single Print Head Kits (5765-253 or 5765-258)		
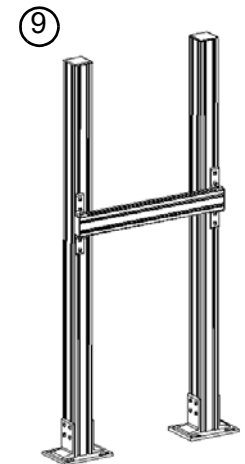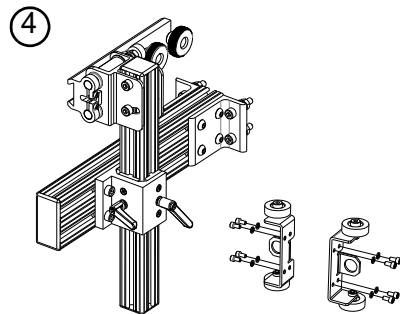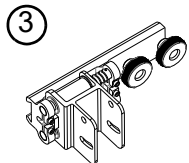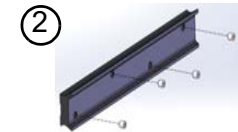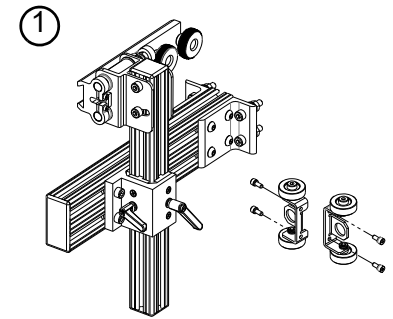
Fittings and Tubing

| Part No.	Description	Contents	Where Used
1301-468	Tubing, 1/8" ID x 1/4" OD	50 foot roll	External plumbing of impulse jet products
1301-871	Tubing, 3/16" ID x 5/16" OD	50 foot roll	External plumbing of impulse jet products
5765-207	Fitting 5361-338, 1/8 Barb x 1/8 Flow Bulk-Head Male Valve	5 fittings per kit	Vacuum port on rear of print head and bottom of SMART-IDS
5765-208	Fitting 5361-329, 1/8 Barb x 1/8 Flow In-Line Male	5 fittings per kit	Connects to print head ink port and SMART-IDS ink port, or any female fitting
5770-263	Fitting 5765-721, 3/16 Barb x 1/8 Flow Female	5 fittings per kit	Connects to print head vacuum port and SMART-IDS vacuum port
5765-209	Fitting 2460-120, 1/8 Barbed Tee	5 fittings per kit	Ink supply lines
5765-210	Fitting 2460-143, Luer Cap, Male	5 fittings per kit	Cap for vent ports on the print head and SMART-IDS
5765-241	Fitting 5765-562, Luer, 75 Micron, Male	5 fittings per kit	Filter for vent port on back of print head and top of SMART-IDS

IJ4000-HMI

Item	Part No.	Description
1	5765-221	Kit, Replacement Display, IJ4000-SS, 10.2"
2	5765-222	Kit, Replacement, CPU, IJ4000-HMI

IJ4000 SMART-IDS

| Item	Kit No.	Description	Item	Kit No.	Description
1	5760-332	Kit, Replacement, High Resolution Interface Board	11	5760-337	Kit, PCB Replacement, Ink Supply
2	5760-392	Kit, I/O Board	12	5760-338	Kit, Power Supply Replacement, 12V
3	5765-247	Kit, Replacement/Upgrade, Power Supply, SMART-IDS	13	5765-461	Kit, Switch, USB
4	5760-372	Kit, Beacon Replacement	14	5765-256	Kit, Interface Board Upgrade, IJ - Additional Task (includes Power Supply, Interface Board and Cables)
5	5765-381	Kit, Replacement, CPU, SMART-IDS	15	5760-342	Kit, Waste Bottle Replacement (2/Pack)
6	5760-335	Kit, Liquid Pump Replacement	16	5760-341	Kit, 12V Bulb Replacement (2/Pack)
7	5765-255	Kit, Internal Tubing & Fitting Replacement	17	5760-344	Kit, External Fittings
8	5760-339	Kit, Reservoir Replacement, ScanTrue	18	5765-269	Kit, Cable Tie Mount (10/Pack)
9	5760-336	Kit, Vacuum Pump Replacement	19	5765-270	Kit, Distributed Vacuum Upgrade
10	5760-340	Kit, Separator Replacement			
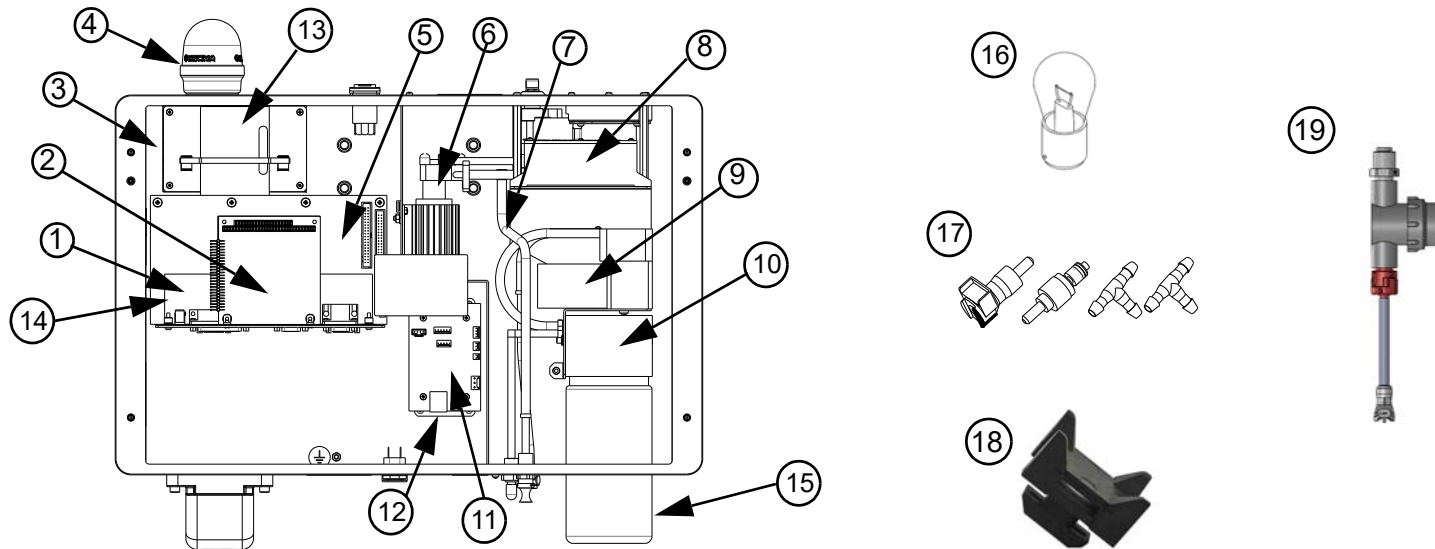
Cables

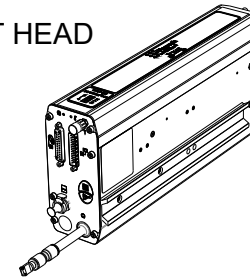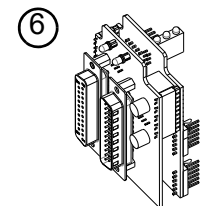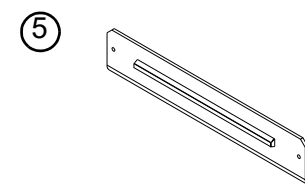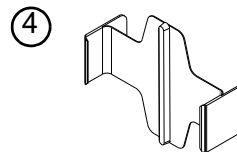| Kit No.	Description
5760-614-002	Cable, IJ4000 SMART-IDS to Print Head, 2'
5760-614-010	Cable, IJ4000 SMART-IDS to Print Head, 10'
5760-614-025	Cable, IJ4000 SMART-IDS To Print Head, 25'

Print Head Replacement Parts

384E PRINT HEAD
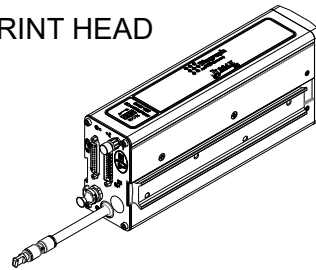
768E PRINT HEAD

Item	Part No.	Print Head	Description
1	5765-238	384E	IJ384E Roller Bracket Kit
2	5765-254	768E	IJ768E Roller Bracket Kit
3	5760-835	384E & 768E	Roller Replacement Kit (5 Rollers)
4	5765-242	384E	Orifice Cover Plate
5	5760-813	768E	Orifice Cover Plate
6	5765-272	384E & 768E	Kit, Print Head PCB, 384E/768E

① ② ③ ROLLER ④ ⑤ ⑥
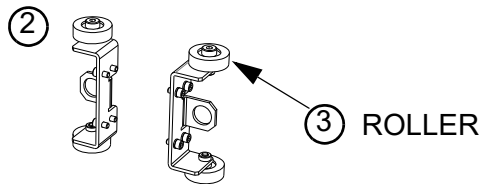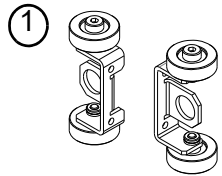
Consumables

Part No.	Description	Contents
001-0598-01D	ScanTrue® II, Pigmented Oil Based for Porous Media, Black	1 Bottle, 500mL
001-0813-01D	ScanTrue® II, Pigmented Oil Based for Porous Media, Black	1 Bottle, 1L
001-0961-01D	ScanTrue® II PLUS, Pigmented Oil Based for Porous Media, Black	1 Bottle, 500mL
001-0988-01D	ScanTrue® II PLUS, Pigmented Oil Based for Porous Media, Black	1 Bottle, 1L
001-0899-01	ScanTrue® II, Flush/Storage Solution	1 Bottle, 500mL
5760-695	Impulse Jet Maintenance Spray for ScanTrue© II	2 Pack, Spray Can
5760-800	Start Up / Cleaning Kit	Gloves, Lint-Free Wipes and Foam Swabs
5760-832	Sponge Swabs	100 Sponge Swabs
5760-891	ScanTrue© II Flushing / Re-inking Kit	2 Bottles Flush Solution, 1 Waste Bottle, 1 Syringe and 1 Reservoir Ship Cap
6600-171	Lint-Free Wiping Cloths	300 Cloths

NOTE: Use only the same type of ink that shipped with the system. Never mix ink types.

Service Parts and Optional Equipment

Item	Part No.	Description
1	5760-820-IJ	Encoder Assembly w/Mounting Bracket & 25' Cable
2	5760-383	Photosensor, Diffuse Type w/ 20' Cable
3	5760-345	Beacon, Remote and SMART-IDS
(not shown)	2464-182-010	Extension Cable, 10' - for Encoder or Photosensor
	2464-182-025	Extension Cable, 25' - for Encoder or Photosensor
4	5760-614-002	Print Head Cable Assembly, 2'
	5760-614-006	Print Head Cable Assembly, 6'
	5760-614-010	Print Head Cable Assembly, 10'
	5760-614-015	Print Head Cable Assembly, 15'
	5760-614-025	Print Head Cable Assembly, 25'
5	5765-206	Encoder O-Ring Replacement Kit, contains: O-ring, 2-7/8 ID x 3-1/8 OD x 1/8 W - 3; O-ring, 4-7/8 ID x 1/8 W - 3; O-ring, 2.175 ID x .103 W - 2

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⑤ O-RINGS