

MCE-Based Machines

Imaging Artifacts

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Revision History

Revision	Date	Author	Comments
1.0	2003-05-07	Greg Hall	Creation
1.1	2003-05-08	Greg Hall	Added Procedure for submitting an artifact section.
1.2	2003-05-13	Greg Hall	Revised some questions in Section 7 (now 8) based on reviewers comments. Added definition of vertical and horizontal.

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1. PURPOSE

The purpose of this document is to catalog several imaging artifacts that have occurred on MCE-based machines. Each artifact is described and a picture is provided when possible. The solution for the artifact is also described if it exists.

2. DEFINITIONS

2.1 Direction

Vertical = Mainscan = around drum = perpendicular to carriage travel

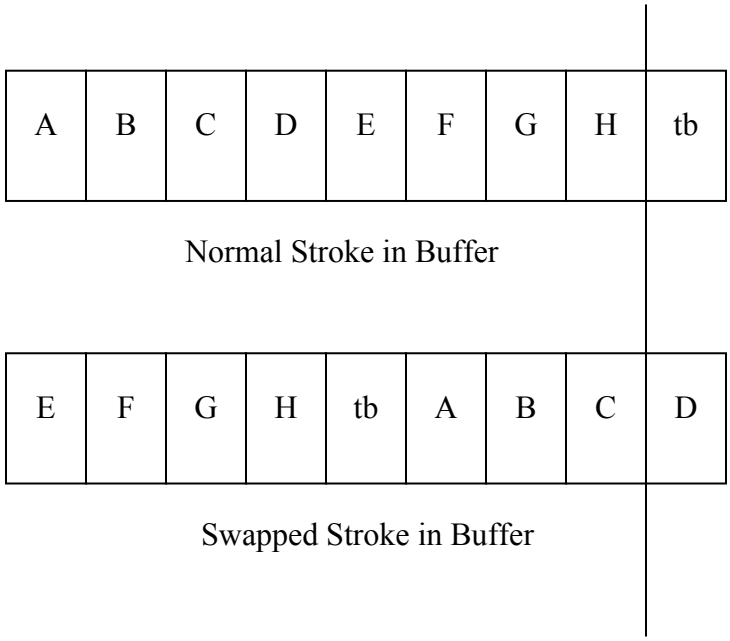
Horizontal = Subscan = along drum = parallel to carriage travel

3. SWATH DATA REVERSAL ARTIFACT

3.1 Description

The swath data reversal artifact is characterized by white vertical lines 8-pixels wide that run the length of the image in the Mainscan direction. These white vertical lines are separated by a swath width (~2.4 mm with a 224-beam head at 2400 DPI). The other major distinguishing feature of this artifact is the swapping of swath data around the white vertical line.

The white vertical line (referred to as the trailing byte) is actually in the approximate middle of the imaged swath and the swath data on each side of the line is swapped as shown in the following figure.

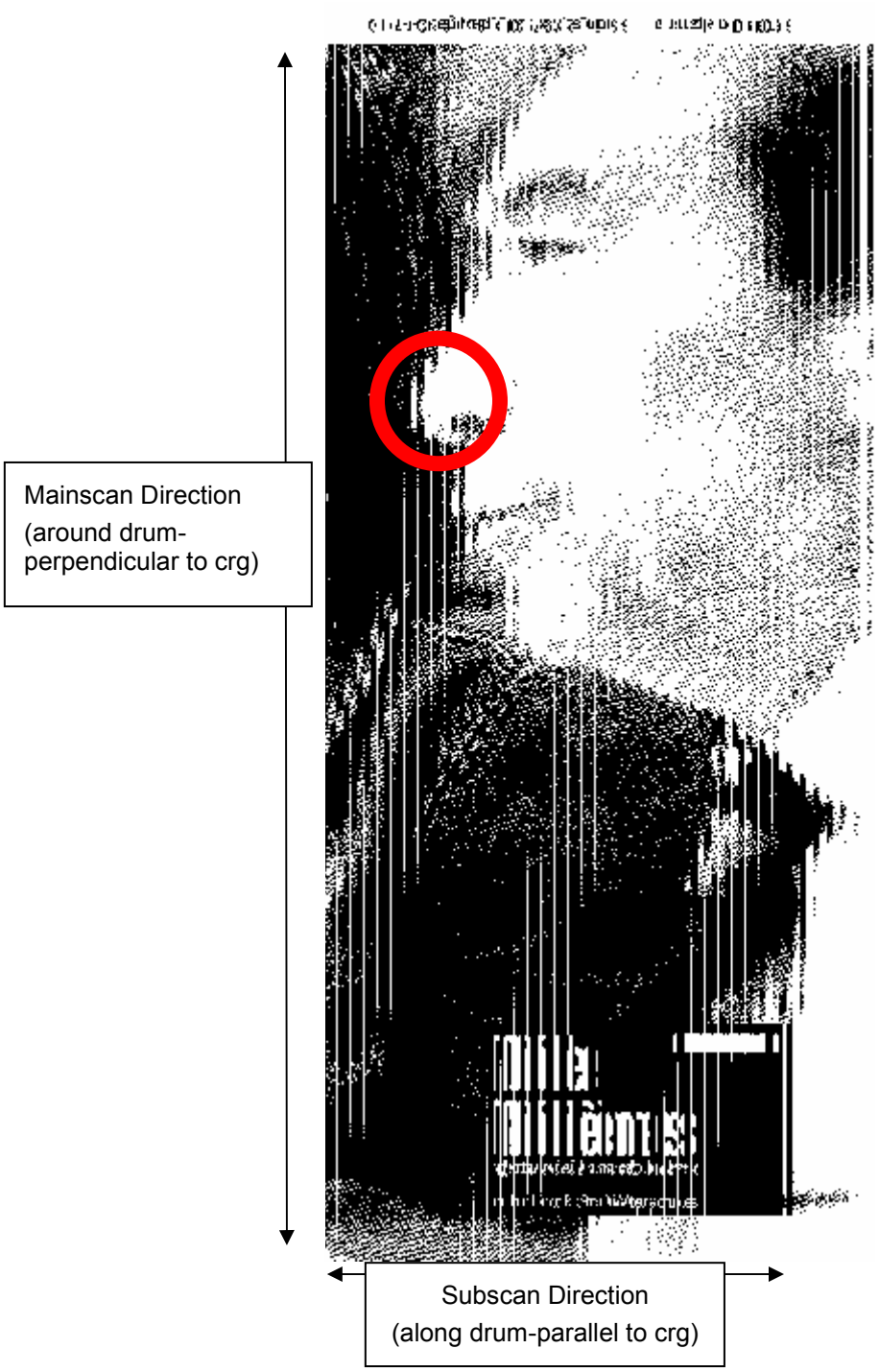


The above diagram represents two different strokes in the imaging buffer on the head just prior to being imaged. A stroke is a set of pixels as wide as a swath and one pixel high. Assume, for this case, that a swath is 8 bytes or 64 pixels wide then a stroke is 1 pixel by 64 pixels. As can be seen above, the data for the normal stroke is stored in the buffer in the order it is received with byte "A" stored in the first byte location of the buffer and remaining bytes stored in succession as the address pointer for the buffer is incremented with each entry. The byte "tb" represents the trailing byte which may contain information for the head but should not be imaged. Most often this byte is all zeros.

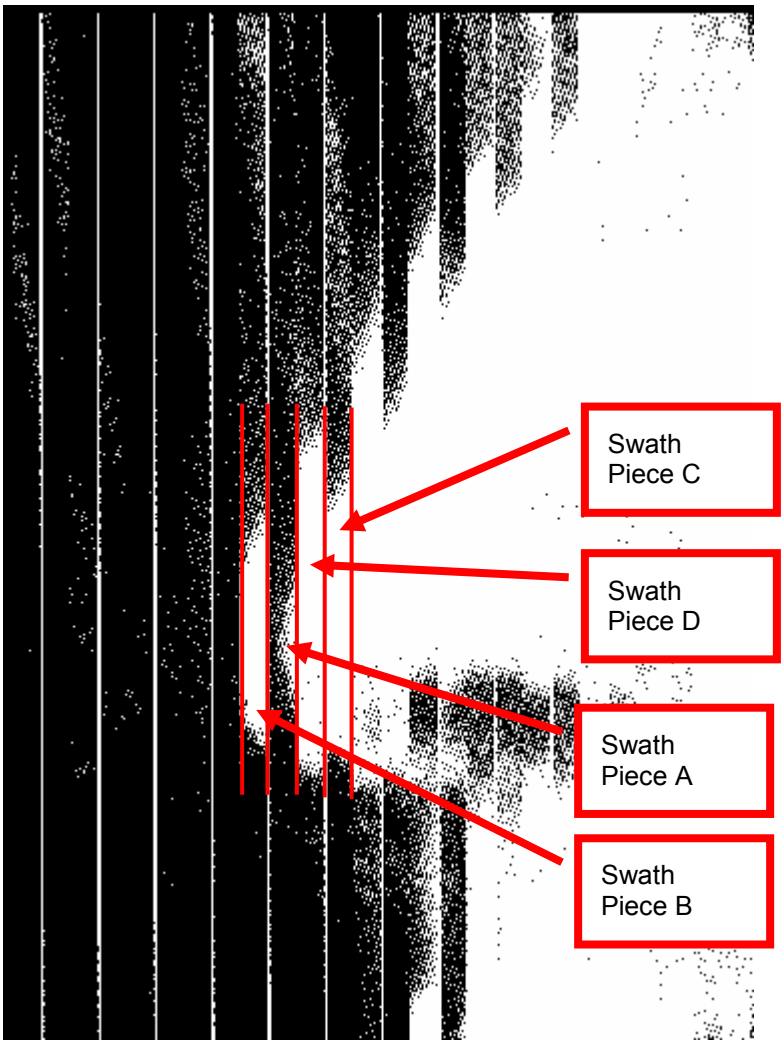
A swapped stroke occurs when the address pointer for the buffer has been advanced prematurely prior to actual stroke data entering the buffer. The swapped stroke illustrated above shows that the address pointer for the buffer was pointing to the sixth byte location in the buffer when stroke data started to arrive. Byte "A" is then stored in the sixth position

with consecutive bytes stored after it as the address pointer is incremented. Since the address pointer is designed to wrap back to 0 when it reaches its maximum, bytes "E" through "tb" appear in the first part of the stroke and bytes "A" through "D" appear in the last part of the buffer. A different address pointer is used for reading the data out of the buffer and it always starts from the first position of the buffer. Therefore, the swath data reversal artifact appears on the plate when the buffer gets into such a swapped state. The white vertical lines are caused by the trailing byte (tb) being imaged.

An example of an image exhibiting the swath data reversal artifact is shown below:



One can see the vertical white lines in the above image as well as the appearance of data being shifted. A magnified version of the area selected by the red circle will show the data reversal more explicitly.



Again, we can see the vertical white lines caused by the trailing byte being imaged. Note that the white lines don't run the whole height of the image due to the resolution of the camera taking the picture. One can see that if swath piece "A" is moved in front of swath piece "B" and swath piece "C" is moved to replace swath piece "B" and so on, then the proper image of the nose begins to take shape as shown below. Swath pieces A and B are part of the same swath just swapped around the trailing byte. The same relationship exists with pieces C and D.



The above picture was manipulated on the computer to place the various swath pieces in the correct order. Once the swath pieces are placed in the right order the image appears correct.

3.2 Cause

The exact cause of this problem has not yet been completely confirmed. We do know that something is causing the address pointer of the stroke buffer in the head to be advanced prematurely thus causing this swapped data problem. Since the address pointer in the buffer is not reset until the beginning of the next plot, this artifact appears over the whole plate.

This artifact has only appeared on the first plot of a machine after a reset or cold start. The time available for screwing up the stroke buffer address pointer on the head is much longer for the first plot then subsequent plots due to the need of doing a stroke balance before the first plot. The likely culprit is unknown states of signals in the Xilinx or microprocessor on the MCE board that control the Hotlink chip used to transfer data to the head.

3.3 Solution

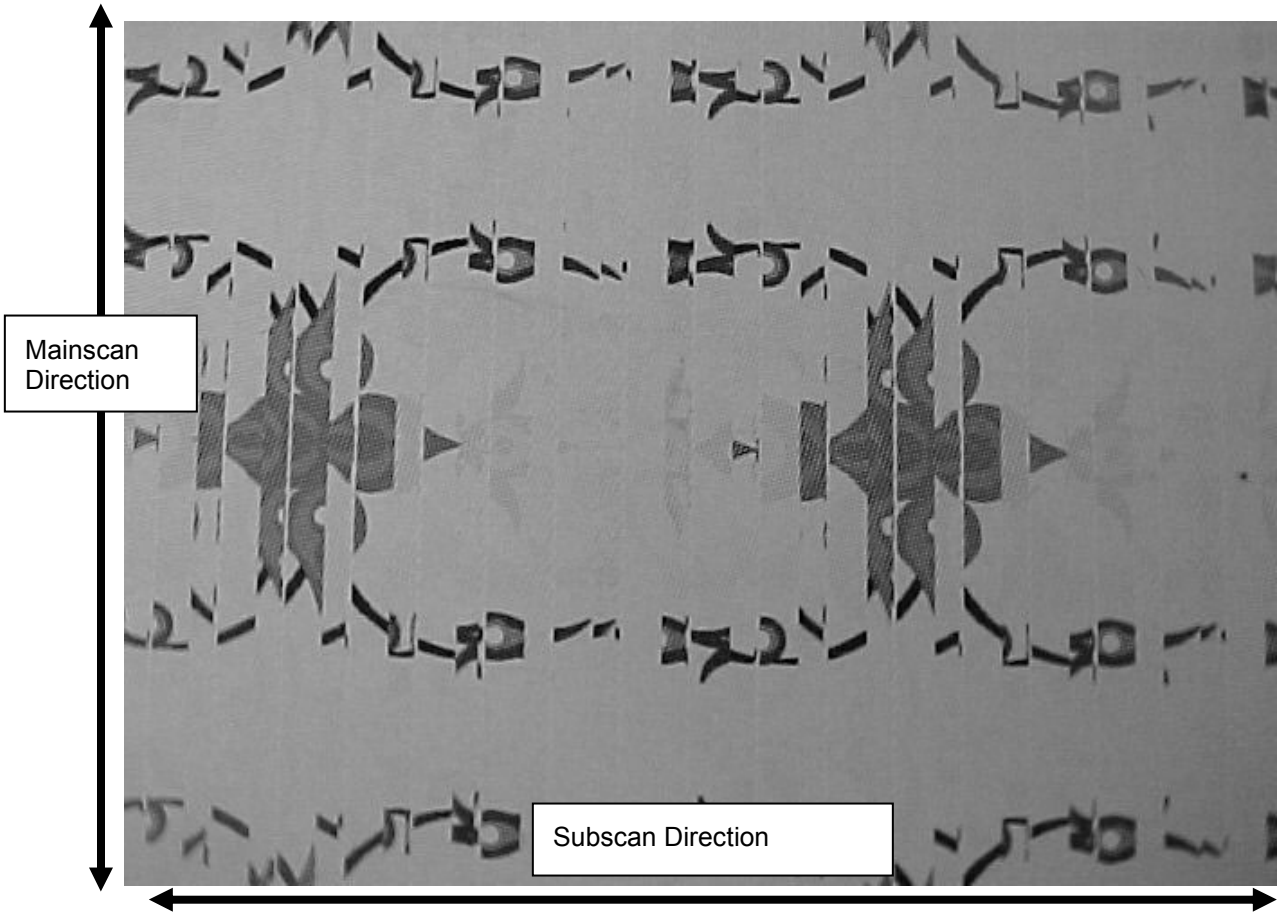
The current solution is to install head firmware version TH1.01H or later which implements a workaround that guarantees the stroke buffer is reset just before imaging data is sent to it. This last-minute reset ensures that the address pointer is reset back to the first byte position prior to receiving real imaging data.

4. MIRRORED SWATH DATA REVERSAL

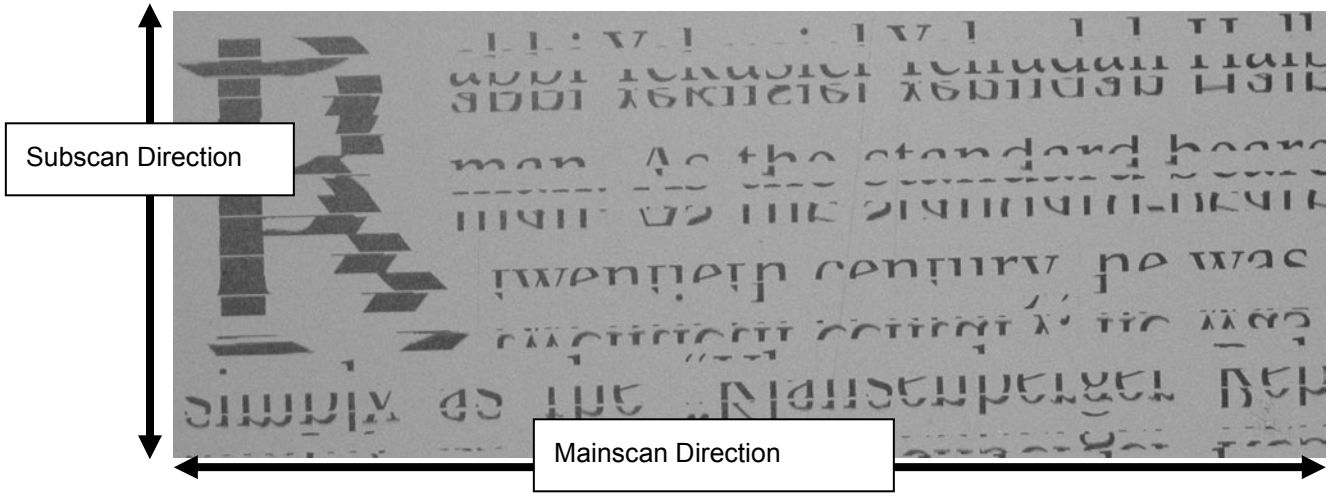
4.1 Description

As the title notes, this artifact is essentially the swath data reversal artifact described above with the added bonus that one of the portions of the swath that is swapped is also mirrored.

An example of the artifact is shown below:

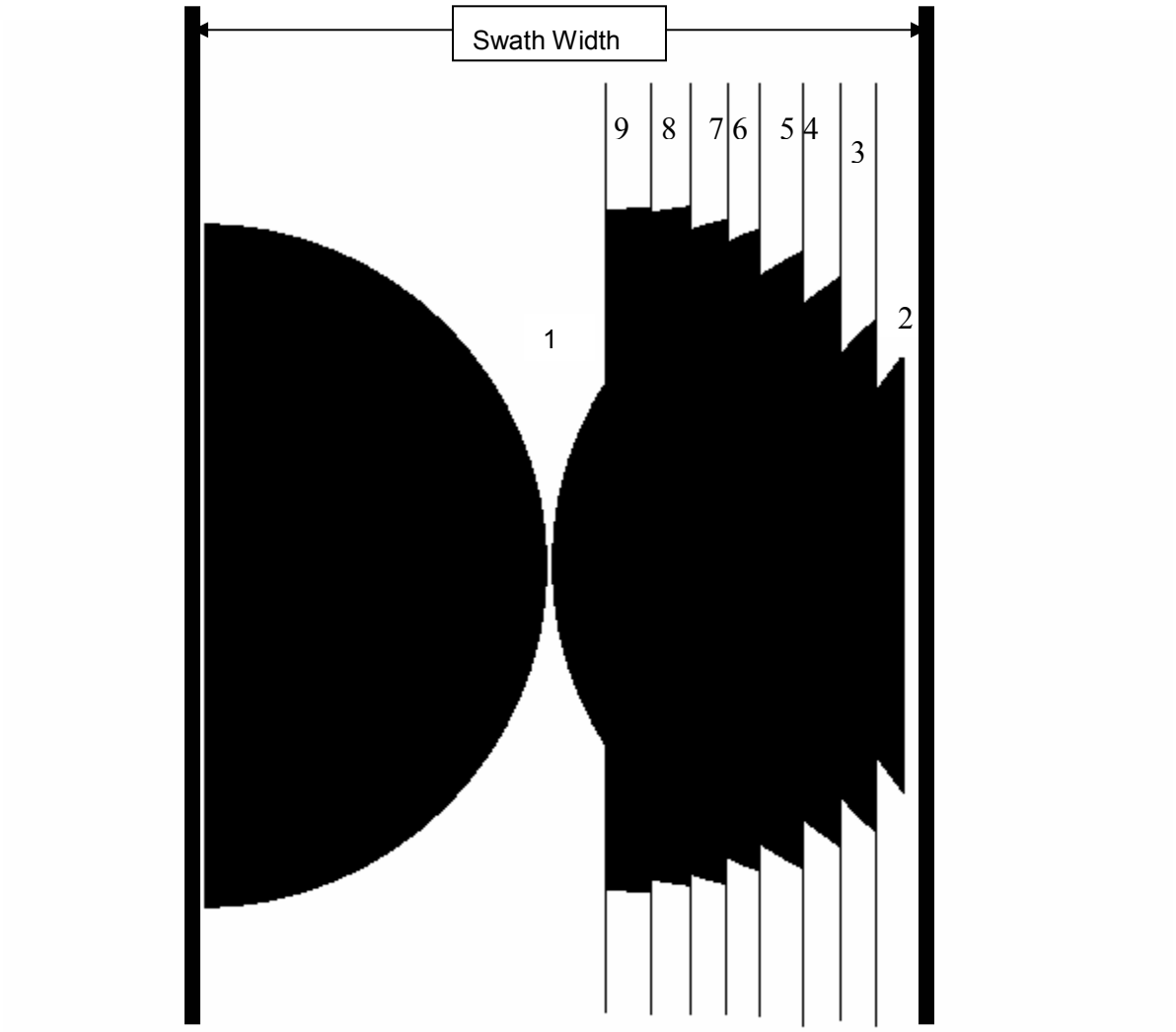


Here is another picture oriented differently, but showing that the data appears to have been mirrored.



We can see in the above image that the pieces of text that have been shifted appear to have also been mirrored. This effect is particularly visible with the letter Y's in the second and third words of the top line. You can actually also notice the mirroring in the first image when looking at the outer circle component of a swapped piece of data. The arc is going in the wrong direction to be just shifted. It has also been mirrored.

The mirroring of one portion of the swath is actually byte-order mirroring not bit or pixel order mirroring. The following diagram attempts to show how the swath is effected.



From the above figure, we see the swath data reversal effect exhibited by the last half of the circle appearing in the first half of the "swath". The new, mirrored effect is seen affecting the first half of the circle shown in the last half of the swath with sections 1 through 9. These numbers represent the correct order of the circle sections. The data has been "mirrored" or essentially reversed or rotated on a byte basis within a swath.

There are two significant differences from the swath data reversal artifact:

- This artifact appears on random plates. It is not isolated to the first plate after reset.
- At some points in some of the mirrored portions of swaths, extra data appears very similar to the traffic congestion artifact (see below) seen before. As if staccato has gone

wild, or the image data was corrupted with noise. This extra data only appears in the mirrored portion of the swath, not the non-mirrored portion.

4.2 Cause

A cause for this has yet to be determined. Clearly something is causing the address pointer in the stroke buffer in the head to be advanced prematurely. This causes the swath data reversal. We have yet to understand how the data is being mirrored on a byte by byte basis in the last half of the swath. The portion of the datapath that deals with data on a byte level is the Hotlink connection between the MCE and the head. Also, we have not yet got an understanding as to how the extra, corrupted "Traffic Congestion" data is appearing on the plate.

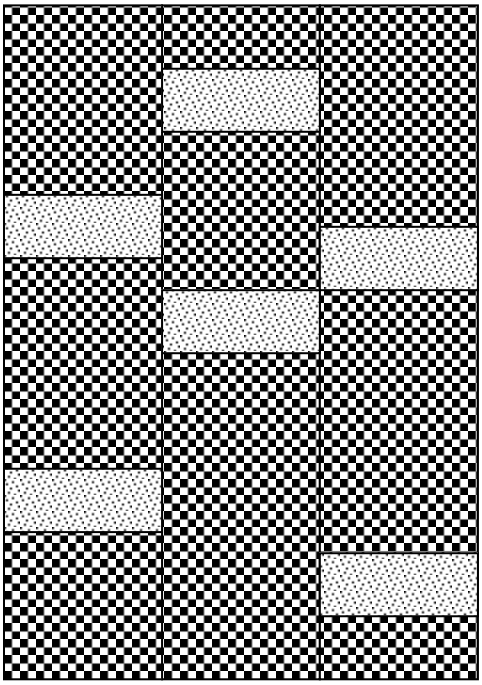
4.3 Solution

None yet

5. TRAFFIC CONGESTION

5.1 Description

There are two manifestations of this artifact. Both include what appears to be extra or corrupted data appearing as a band within a swath. The corrupted data appears to show up along a swath in a regular interval but can vary in position between swaths. The following diagram attempts to illustrate this artifact.



Assuming the above image was meant to be three swaths of a checkerboard pattern, the extra bands represent the extra data that appears superimposed on the actual data. This superimposed data often looks like noise or as if the normal image data has been compressed, but the swath never appears compressed in the mainscan.

A second version of this artifact also includes the swath data reversal.

5.2 Cause

Not sure yet. Seems to be of low frequency and low priority. Could be noise in some part of the system but seems to regular for that.

5.3 Solution

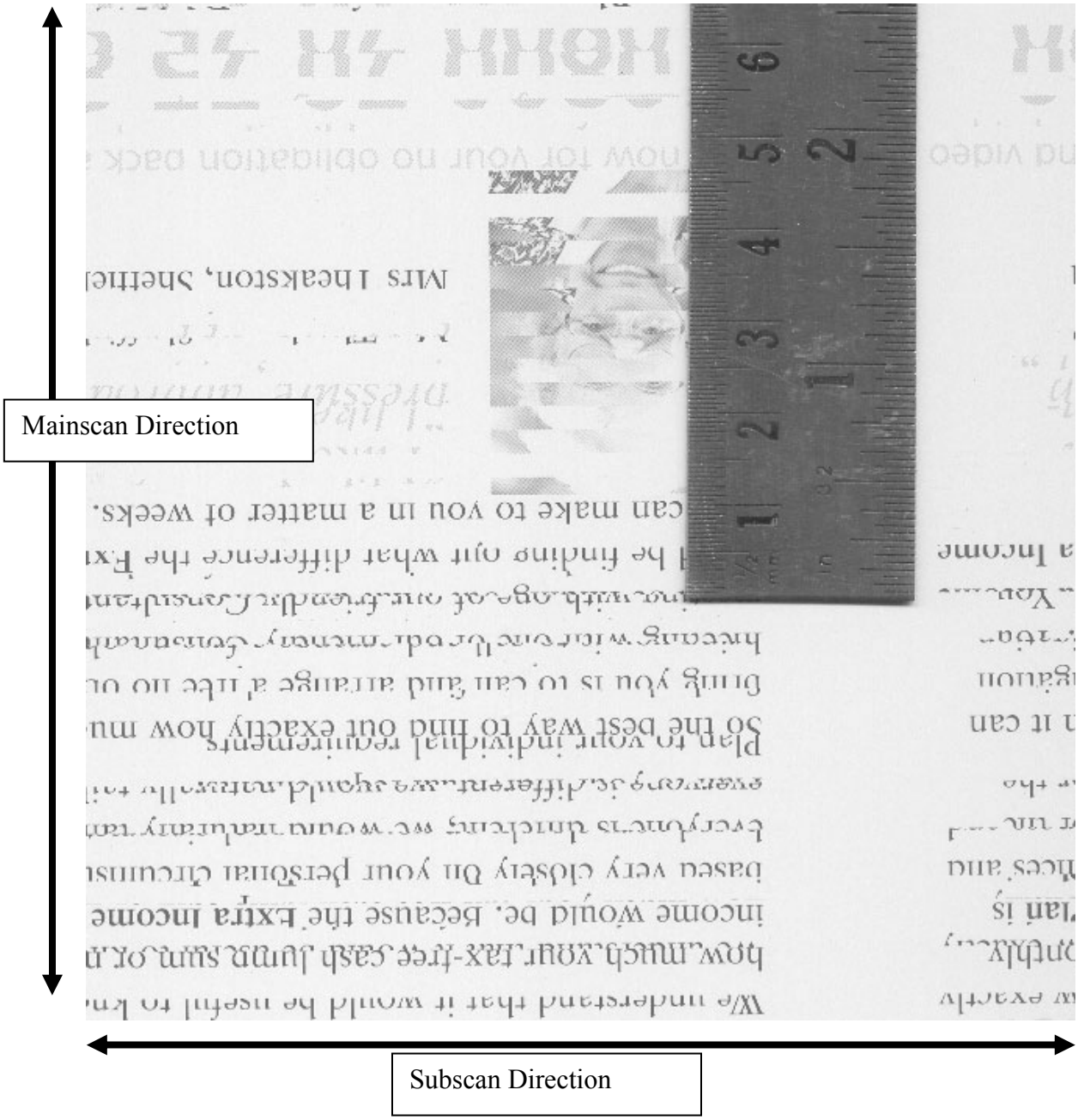
None yet

6. HORIZONTAL DATA SWAP

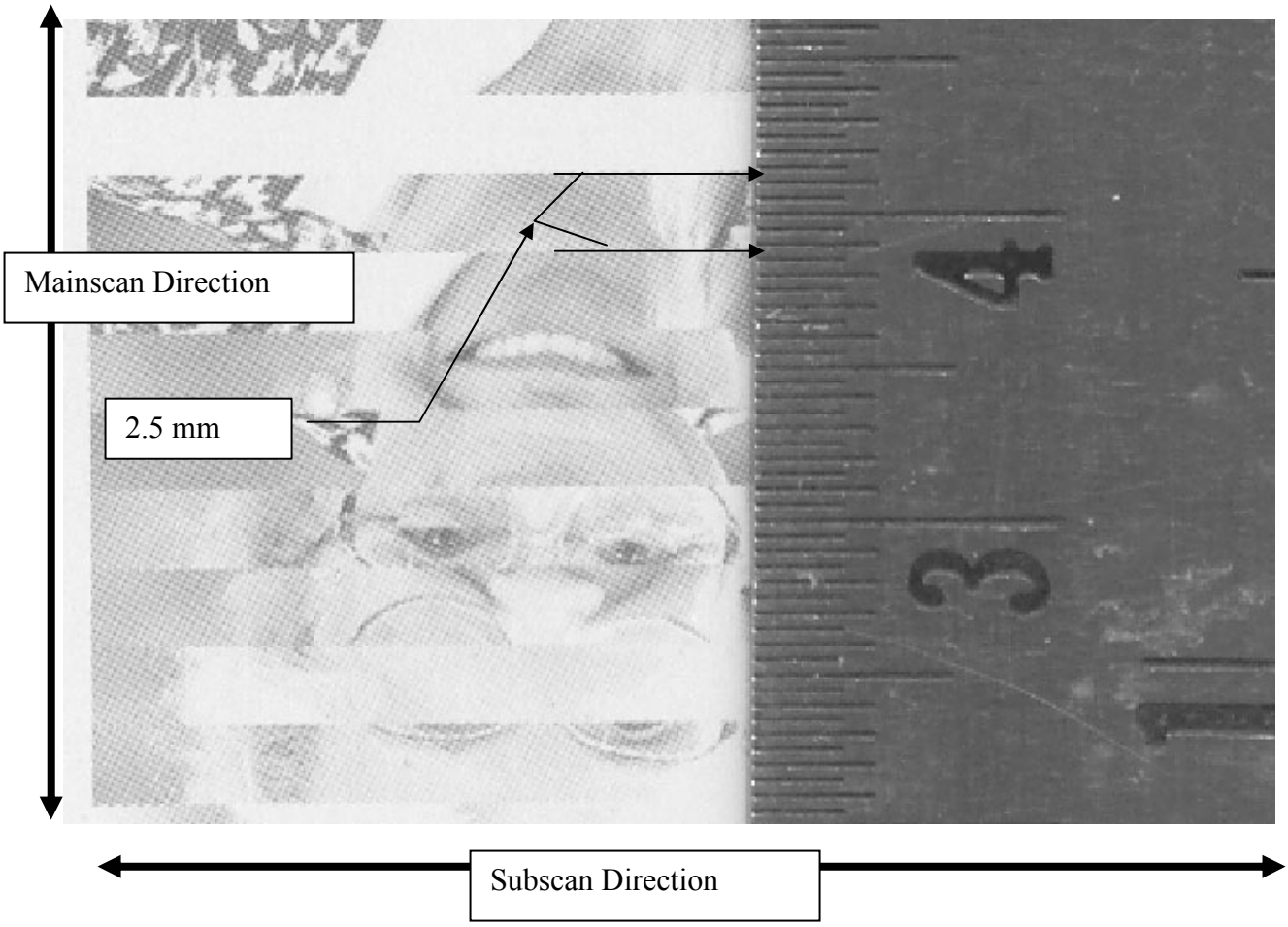
6.1 Description

- Characterized by horizontal (in subscan direction) swaths of data that are shifted around the drum in the mainscan direction 5 mm from their original positions.
- This artifact has been seen in UK, Japan, Belgium (demo machine) and on the production line in Israel.
- Most of the machines it has been seen on are Brisque – Lotem Quantum Systems. Yossi Dror and Shmuel Gerbi have indicated it has been seen on Prinergy machines as well but it is unclear whether they mean this shift or the swath data reversal artifact.

Here are examples of the artifact. First, an overall view of a plate with a ruler and the artifact on it from England.



We see that sections of data in the along-drum direction are shifted around the drum. Here is a zoomed in version of the above picture.



From the above picture, we can see that the bands of data appear to be about 2.5 mm tall in the mainscan direction and that they are moved 5 mm from their original position.

At least one other site in Japan (Yaron Shifman is the CSE) has confirmed that the artifacts he has seen have the same dimensions.

6.1.1 First Impressions

Some initial thoughts:

- The total shift distance of ~5 mm corresponds nicely with 512 pixels at 2540 DPI in the mainscan direction.
    - Note that the input buffers in the TMCE Xilinx are 512 bits.
    - Also, TSP packets are 512 bits
- Perhaps significant that the shift is neatly split into ~2.5 mm or 256 pixels in the mainscan direction
- The artifact is exhibited over the entire plot indicating something that is not reset during the plot is affected.

- Likely related to some sort of address counter problem

6.2 Cause

Research has shown that it is extremely difficult for the MCE input buffer state machine to cause a flip of data as seen in this image. The state machine was made very robust when trying to solve a TSP bug some time ago. We're not necessarily ruling out the possibility that something in the MCE is causing this but it may also be something in the TSP link or something on the TSP side. Not sure, we have not been able to narrow it down yet.

When this was appearing at McLay's in the UK, the service engineer mentioned this appearing after a problem with the TSP board. Once he reset the TSP board, this went away. Could be some issue in handshaking between the TSP and MCE.

6.3 Solution

None yet

7. LEGACY DATA SHIFTS

These are some older issues that have been resolved that Bill Dall described in an e-mail some time ago. I want to expand then out a bit more before we publish this document for service engineer, but I'm including them in here for completeness.

If the data path bug can be described as this:

- Very thin (hairline) horizontal lines about 0.33 mm apart.
    - The cause can be a bad DRAM connection in the MCE. A solution that sometimes works is to open the top cover, remove the DIMM and then just put it back in. Otherwise, must replace the board.
- Very thin (hairline) horizontal lines about 0.16 mm apart.
    - There are two possible cases if you're using SCSI datapath. If an internal test plot from the MCE looks fine, then the problem is probably on the SCSI interface, so removing and reconnecting the SCSI cable is a good thing to try. If the test pattern also contains the lines, then re-set the DRAM as per the procedure, above.
- Thin (80 um) horizontal lines about 5 mm apart (the data-shift artifact). Horizontal lines are not white or black but contain data from other areas.
    - Make sure you're using Xilinx version 1.37 and above. If you are, then tell us about it. This should be impossible now. V1.32 had a number of timing problems which caused some good MCE's to look bad.
- TSP connection artifacts can show up as being 0.8 mm apart and can be on every second line vertically (since even and odd lines come from separate TSP's)
- Vertical lines are usually caused by carriage or head issues. It is difficult for the data-path to cause a vertical line, but it can happen.

8. PROCEDURE FOR SUBMITTING AN ARTIFACT

When the need arises for submitting an imaging artifact for analysis, please follow the outlined procedure below:

1. Obtain a sample of the artifact on plate or proof AND a sample of what the image SHOULD look like on plate or proof
    a. As mentioned below, send a picture right away since shipping plates takes time. This will allow us to get a headstart before the sample plates arrive. Try to have some indication of scale in the picture, like a ruler.
2. Answer as many of the following questions (not necessarily all) as possible in an e-mail or document:
    a. Describe the problem and provide a diagram or picture (the diagram or picture will help the analysis begin while waiting for the plate samples – note that picture is best ideally with some indication of scale like a ruler). When describing the artifact consider the following:
        i. **Does the artifact match any of those described in this document?** If so, say so then don't worry about describing it in too much detail.
        ii. **Give dimensions of the artifact** i.e. height, width. You can estimate if you do not have the tools available to give an accurate measurement. For example, the Swath Data Reversal Artifact runs the Mainscan length of the plate and is one swath wide.
        iii. **How often is the artifact repeated in the image?** i.e. the Swath Data Reversal Artifact occurs every swath, the Horizontal Data Swap appears to repeat every 5.4 mm or so, and the traffic congestion doesn't seem to have a consistent repeat pattern except that it occurs in every swath.
        iv. **Does the artifact appear to be contained within a swath?** (i.e. Swath Data Reversal or Traffic Congestion) or is it on a larger (Horizontal Data Swap) or smaller scale.
        v. **Give the orientation of the artifact.** Do "along drum" or "around drum" bands or lines appear? Which direction has data been shifted if it appears to have been shifted? Note that:
            1. Vertical = Mainscan = around drum = perpendicular to carriage travel
            2. Horizontal = Subscan = along drum = parallel to carriage travel
        vi. **Has the data been completely corrupted or is correct data visible but just moved to the wrong place in the image**.

vii. **Is the artifact ortho corrected** i.e. parallel to other portions of image or side of plate? Or does it appear to be at a slight angle to the proper image data or side of the plate?

viii. **Any other features of the artifact**. Every little bit helps.

b. **How frequently does the problem occur?** Daily, weekly, yearly?

c. **What work/upgrades/fixes have been done recently on this machine?** Did the problem start showing up since something else changed?

d. **What is the effect on the customer?** Are they completely unable to use the machine? Are they able to progress at reduced capacity? Or does this artifact have little affect on their productivity?

e. **What is done to reproduce the problem?** if possible.

f. **What, if anything, is being done as a work around?**

g. **What, if anything, has been done to try and solve the problem?** i.e. replaced TMCE boards or cables etc.

h. **Are there any factors that make the problem more or less likely to occur?**

i. **TSP/scsi/tpg?**

ii. **power on? reset?**

iii. **plots of different dimensions?** (eg big, small, tall/skinny, short/fat)

iv. **different separations?**

v. **Anything else?**

i. **How many machines has the problem been seen on?**

j. **Is it being seen with TSP plots? scsi plots? tpg plots?**

i. If TSP, is it a 1-TSP card system or 2?

k. **What head firmware, TMCE firmware and Xilinx (FPGA) versions are running on the system?**

l. **What type of a machine is the artifact occurring on?** Lotem 800 Quantum, Lotem 400 Quantum, Trendestter MCE etc.

3. Obtain logs from the machine for when the artifact occurred.

4. If possible, obtain raster source as well. Not as high priority, but sometimes may prove useful.

5. Send 1, 2, 3 and 4 to the person who will analyze the problem then expect more questions.

a. Since sending the plate and/or proof samples will take time, attempt to send items 2 and 3 by e-mail as soon as possible.