UW- Sat Reports
ATS-ATP Guides

UNIVERSITY OF WISCONSIN
ATS DIGITAL DATA
USERS MANUAL

CONTENTS

PURPOSE OF THE USERS MANUAL

This manual has been prepared for in - house distribution to meteorologists who have a need for information about ATS - 1 Spin Scan Camera data stored in digital form. It should serve only as an introduction to the various problems associated with the effective use of these data. Addition and corrections to the contents of the manual will be distributed in the future.

Tom Vonder Haar
Project Supervisor
6 October 1967

GENERAL INFORMATION ABOUT THE ATS DIGITAL DATA

The Spin Scan Camera experiment onboard ATS - 1 measures reflected solar radiation in a narrow, "green", spectral region. The instrument consits of a PM tube with associated optics and its output is transmitted directly to a readout station. Details of this experiment may be found in the ATS Technical Data Report, Vol. 3 (a copy is filed in our ATS library). At the ground station the satellite signal may be:

a) used to obtain a photograph (the EIS product)
b) stored on an analog tape
c) put through an A/D device to obtain a digital tape

In practice, (a) is available each time the experiment obtains a picture, but (b) and (c) are done less frequently.

Pages 2.3 - 2.5 were written by M. Dick of SSEC and provide some details about the format of the digital tapes. Along each ATS scan line, the satellite signal (in millivolts) is sampled by the digitizing equipment at a fixed rate. The linear distance on the earth near the subpoint that corresponds to this sampling rate is about 0.7 n. mi. On the tape this sample is stored as a digital number derived from the millivolt value which was a function of the "brightness" of the region viewed by the sensor. Because 8 binary bits are reserved to record each such sample, the digital data have a possible "gray scale" range from 0 to 256.

Each data sample (sometimes called a "digital element" or "data word") represents the energy received from a nearly circular area with a diameter of about 2 n. mi. (the nominal half - power resolution). As mentioned above, the east - west sampling is about every 0.7 n. mi., and the north - south sampling is determined by scan line spacing (approx. 2.3 n. mi. near the subpoint). On each digital tape the ATS "brightness" data are stored as a "line" vs. "element" array.

ATS-1
Digital Tape Format
February 15, 1967
MLD

Each scan line of the digital tapes made at Rosman, N.C., is written as a single record with the following format:

Words 0 - 8 Line Identification (See attached description)

Words 9 - 4095 each contain two 8-bit data samples

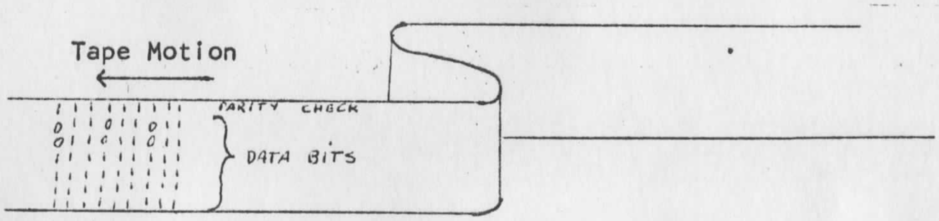
where each word is sixteen binary bits long.

The data records are written on seven track tape. This means that six bits of data and a parity bit are written on the tape at the same time. The parity bit forms a hardware check that the data is read and written properly.

To place sixteen bits of data on the tape in six-bit characters two dummy zero bits are placed before each pair of data samples. These 18 bits are then divided into three characters and written on tape (see figure 2). Assuming that the data has been read as the highest possible value, three data words would look like the following

001111111111111111001111111111111111001111111111111111 (54-bits)

This would be placed on tape in the following fashion



The computers available at UWCC are all made up of 48-bit words. In this case, when the digital tapes are read the following pattern results:

255 255

001111111111111111001111111111111111001111111111
111111001111111111111111001111111111111111001111
111111111111001111111111111111001111111111111111

As can be seen the two extra zeros cause the data words to overlap from one computer word to the next in a pattern which repeats every third computer word. To analyze the data either every program must handle three types of computer words or a single program should remove the zeros and rearrange the data so that it is all in the same format. Each succeeding computer program would then handle a single type computer word thus increasing the efficiency of the programs and reducing the amount of running time required to produce results. If the above example using maximum data values were reformatted the result would be computer words containing all ones.

Note: 8196 samples/line → ≈ 16×10^6 samples/pic → ≈ 132×10^6 bits/pic and 0.36" square region on an 8X10" pic "fills" the CDC 3600

MSB(15) ---------(0)LSB

WORD NUMBER	BIT DESCRIPTION	BIT CONFIGURATION
0	Frame Identifier (A,B)	(0000)(0000)(AAAA)(BBBB)
1	Scan Direction (C); Ground Video Gain (D); Satellite Video Gain (E); Phase-Lock-Loop Error (F)	(0000)(0000)(CDDD)(EFFF)
2	Phase-Lock-Loop Error (G)	(0000)(0000)(GGGG)(GGGG)
3	Day-of-Year (H, J)	(0000)(0000)(HHHH)(JJJJ)
4	Day-of-Year (K); Hours (M,N)	(0000)(0000)(KKMM)(NNNN)
5	Minutes (P, Q)	(0000)(0000)(OPPP)(QQQQ)
6	Seconds (R, S)	(0000)(0000)(ORRR)(SSSS)
7	Scan Mode (T); Vert. Line Count (U)	(0000)(0000)(TOUU)(VVVV)
8	Vert. Line Count (V)	(0000)(0000)(WWWW)(ZZZZ)
9	Two A/D Video Samples	(XXXX)(XXXX)(XXXX)(XXXX)
↓	↓	↓ ↓ ↓ ↓
4095	Two A/D Video Samples	(XXXX)(XXXX)(XXXX)(XXXX)

SYMBOLS:

A = Tens Frame Ident. BCD
B = Units Frame Ident. BCD
F = Phase Lock Loop Error
    2 high-order Bits (Binary)
H = Tens Days BCD
J = Units Days BCD
K = Hundreds Days BCD
M = Tens Hours BCD
N = Units hours BCD

O = Intentional Blanks Added in
    First Nine Core Words

P = Tens Minutes BCD
Q = Units Minutes BCD
R = Tens Seconds BCD
S = Units Seconds BCD
U = Thousands Lines BCD
V = Hundreds Lines BCD
W = Tens Lines BCD
Z = Units Lines BCD

FIGURE ONE

WORD FORMAT FOR CORE MEMORY STORED LINE DATA

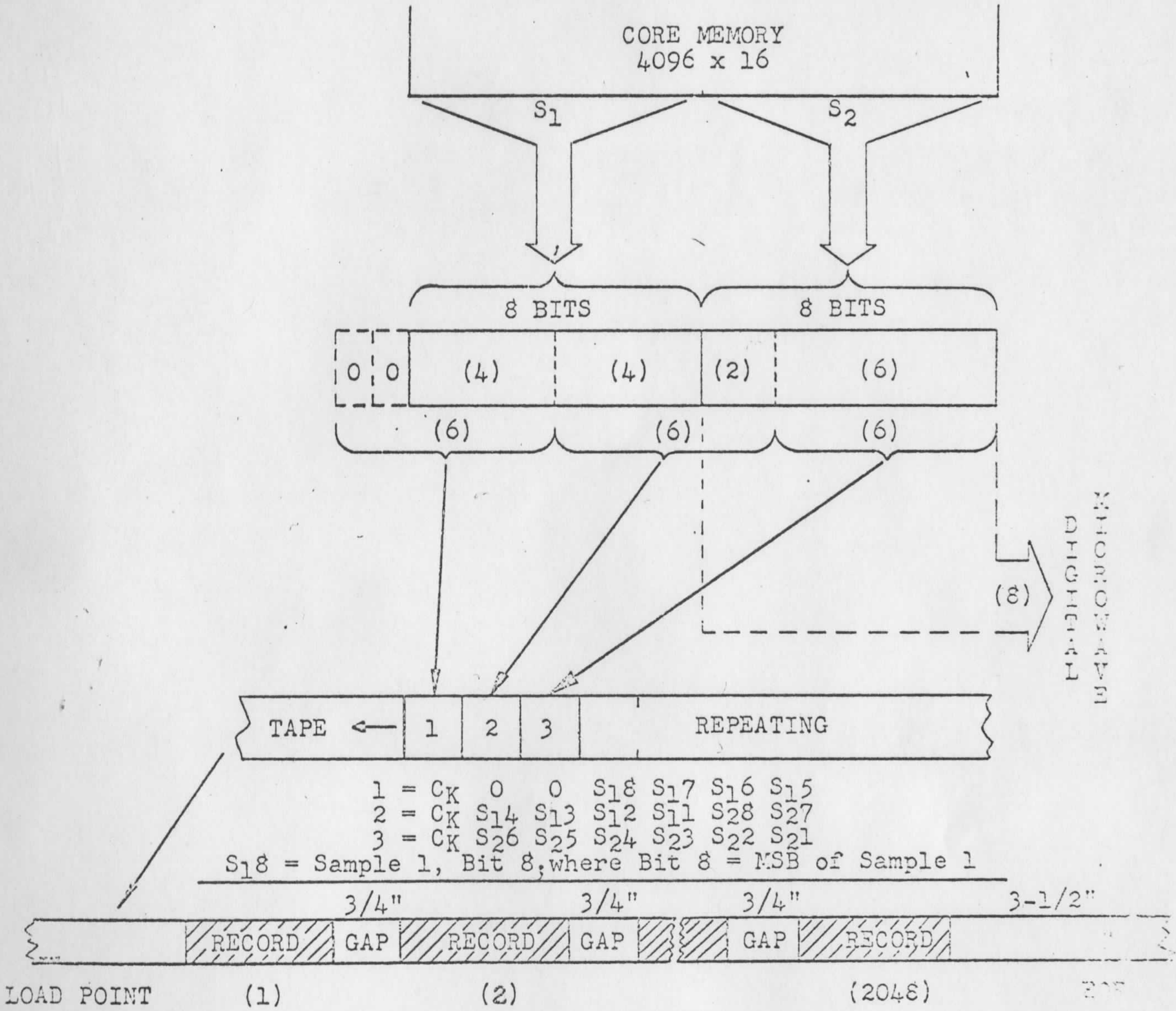


FIGURE TWO

PHASE TWO CORE UNLOAD - RECORD PATTERN

AVAILABLE DIGITAL DATA

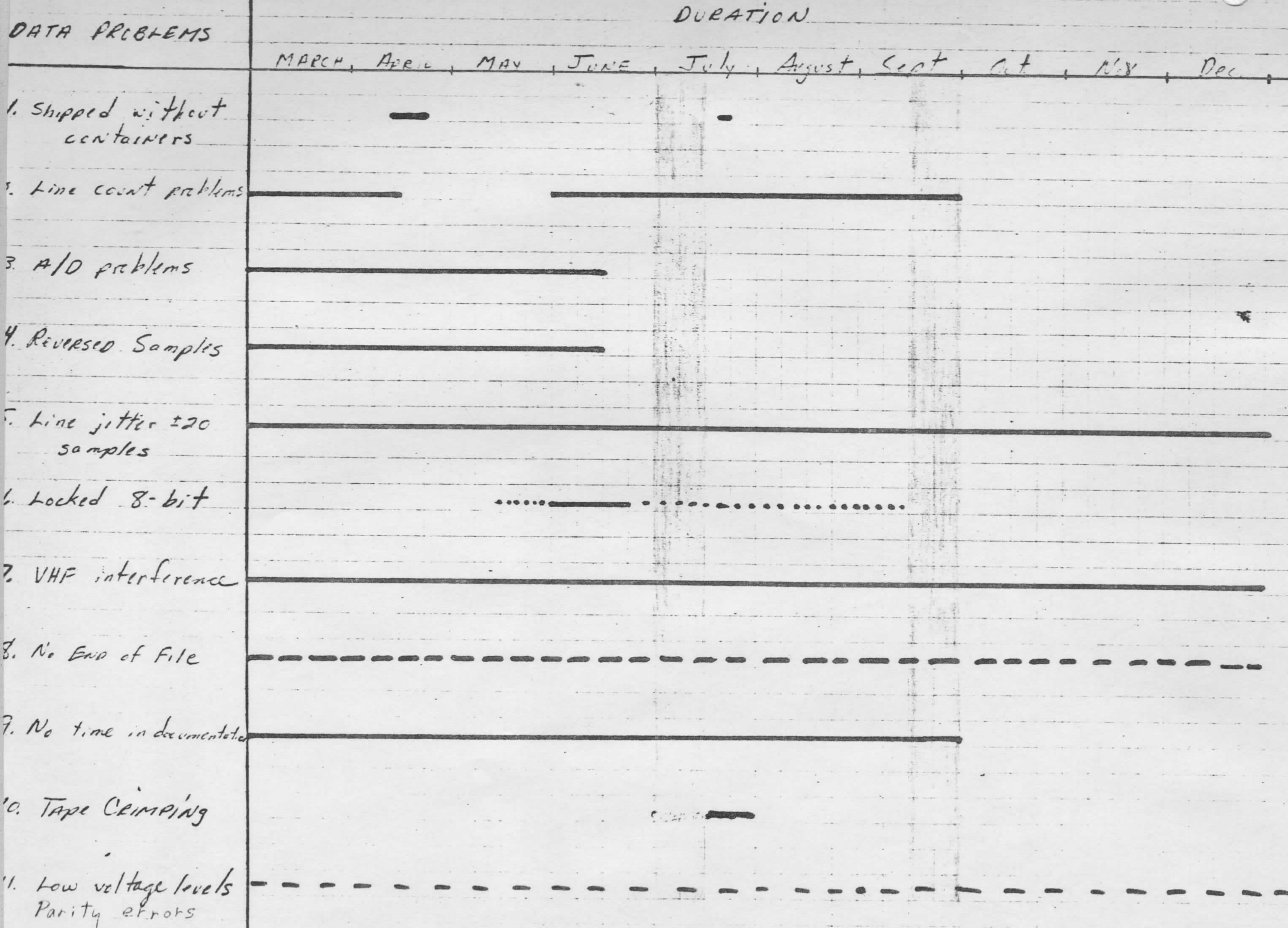
Because one ATS picture in digital form completely fills a special magnetic tape, it is not economical to digitally record all the pictures. In practice, some digital data is obtained each day the experiment and ground stations are in operation. At least once a month an entire day's pictures are digitized. When a tape is made it enters a loop that includes NESC and U of W. Each group has the option of copying those tapes they wish and eventually all tapes are returned to the station where they are used to record a new picture. A list of the days and pictures available on tape is distributed by our ATS library.

Mary Dick of SSEC has recently compiled a list of "problems" that effect our digital tapes. These notes are reproduced on the next two pages and can serve as an additional guide to the selection of digital data for scientific use. Some to the problems effect programming efficiency, some effect the scientific worth of the data and some have both effects. For more detailed information check at SSEC.

ATS-B Tape Problems Noted at ESSA and Univ. of Wis.
October 1, 1967

1. Shipped without cannisters -- one with a bug in tape (dead).
2. Erratic line count - Are lines or just line numbers skipped?
e.g. 21,20,21,24,25,24,25,28 etc., e.g. 80-89, 80-89, 100-109, etc.
3. Hard copy & tape numbers do not match.
4. Oxide shedding on Audio Devices tape.
5. A/D problems (extra bits) until June 14, ok after June 15.
6. Reversed sample order, ok after June 15.
7. Line jitter, ± 20 samples.
8. 3M Company 2750' tape, when new, does not fit on reel.
9. All zero records near start of tapes - line numbers were, for example, 3,0,4,0,5.
10. Locked 8 bit - cable connector problem.
11. Completely blank tapes have been sent as pictures.
12. Parity errors or maginal voltage levels caused one tape, read on two B5500 tape units, to take 43 minutes to read on one unit, vs. 12 minutes on another tape unit.
13. No ends of-file. Tape runs off end of computer tape unit.
14. No time in documentation words.
15. Voltage level low on track one. - Tape 336 for September 2.

10-2-67
MLD



Vertical bars indicate periods when NO tapes were made.
Dotted line indicates problem is intermittent.

DISPLAY TECHNIQUES

The vast amount of digital data that is contained in one ATS picture cannot be explotted scientifically unless it is readily accessible to the user. With this in mind, a joint scientific - programming effort has already developed a variety of digital display techniques. Eric Smith of SSEC provides details of these methods in the next several pages.

Although at first inspection these techniques may appear useful in providing a pictorial representation of the ATS data, this is not their prime purpose. In all cases, the display techniques are best suited for obtaining quantitative information on the area and energy reflected from the object in view. As such, they provide a valuable addition to , rather than a substitute for, the standard video products.

Some additional information on the display and application of digital data to meteorological problems will soon be available in papers by Smith and Vonder Haar and by Hanson and Vonder Haar.

Program : CHRDSPLY

Language : F-63/Compass

Computer : 3600

Programmer: Eric A. Smith

Date : June 6, 1967

Purpose : This program is a general purpose character display program designed to allow the user to specify a printer character to a range of values over elements of a grid and then outputting the grid, in character form, on a line printer.

Usage : The program requires that the user write his own input subroutine. The program calls this routine with a CALL INPUT (IDIMI, IDIM2, GRID) statement, where IDIM1 = the number of columns and IDIM2 = the number of rows (read in prior to the call as will be explained) of the input area GRID. Since GRID is a lineary array, the subroutine must make provisions for storing the elements in the standard linear format, i.e., rowwise. After the input routine is prepared, the subroutine deck should be placed in the program deck, following 3600 program order rules. If this subroutine requires the reading of its own control cards, note that they must be positioned so as not to interfere with the main control cards. (see below)

The program is set up to process a series of input grids under one set of parameters with the provision of reinitiating the parameters for a second series and so on. The following parameters are required on control cards.

First Control Card:

Col. 1-3 : number of columns of the following series of input grids.

Col. 4-6 : number of rows of the following input grids.

Limitations: $((NC-1)/8 + 1) \times NR$ cannot exceed 4000.
$NC \times NR$ cannot exceed 32000.

Col. 7-9 : the number of intervals to which characters are to be assigned ($2 \leq NI \leq 64$)

Col. 10 : 0 specifies that the BCD characters to be used will themselves be read in on the following card in a 64 R1 format. They should be punched in order as to their assignment to an ascending set of intervals.

1 specifies that the octal codes (internal) of the BCD characters to be used will be read in on the following card in a 40 02 format, (use two cards, if necessary). This feature enables the user to have access to the complete set of printer characters, otherwise unavailable on the keypunch. The codes should be punched in order as to their assignment to an ascending set of intervals.

Only one type may be used.

Col. 11: 0 specifies that the size of the intervals over the range of values is uniform (see below).
1 specifies that the size of the intervals over the range of values is non-uniform (requires the third control card).

Col. 12-21: If column 11 contains a 0 punch, this parameter specifies a floating point number which is the upper bound of the first interval, (F10.4, if decimal is not punched).

Col. 22-31: If column 11 contains a 0 punch this parameter specifies a floating point number which is the size of the uniform intervals, (F10.4, if decimal is not punched). Note that the first and the last intervals are not necessarily equivalent to the specified interval size. This is because the interval bounds are computed by a recursive adding of the interval size to the initial upper bound, and ending with the computation of the upper bound of the next to the last interval. Since the first interval has no lower bound specified, and the last interval has no upper bound computed, these two intervals are, in a sense, open ended.

Col. 32: 0 specifies that line repetition is not used
1 specifies that line repetition is used.

Col. 33-34: Specifies how many spacings will be between print lines; if col 32 is 0, blank spacing is used; if col 32 is 1, the line is repeated; leave blank if no extra spacing is desired.

Col. 35-36: specifies logical tape unit onto which maps are printed ($1 \leq LUN \leq 49$; if left blank or out of range LUN is assigned to 61, i.e. the standard output unit)

Second Control Card:

This card contains either the BCD characters or the octal codes of the BCD characters to be assigned to the intervals. Column 10 of the previous card specifies which type is read. Parameter 3 of the previous card specifies the total number of characters or codes read.

Third Control Card (Optional):

If column 11 of the first control card contains a 1 punch, this card contains the n-1 (may not exceed 63) upper bounds for the n specified intervals (see explanation of uniform intervals). This card allows non-uniform intervals to be chosen. This card uses a 8F10.4 format (use extra cards, if necessary).

After these parameters are read in, a series of input grids may be processed. Preceding each call to the input routine, an 80 column alphanumeric title card must be read in. This information is used as a heading for the character display associated with that input. If new parameters are desired, a card with the word END in the first three columns follows the first group of data input. This procedure may continue with no limitations, however, the final group must be followed by a card with the word FINISH in the first 6 columns, which indicates the run is complete. The user should take precaution to position any control cards read in by his input routine to not interfere with program control and title cards.

The output will be produced in a series of strips with each strip a maximum of 112 columns. Each strip will have the same number of lines as there are rows in the input grid.

Method : The parameter cards are read in and checked for errors. Intervals are computed, if specified as uniform, otherwise they are read in. The program calls the user input routine. After this is complete the program calls its main subroutine CONVERT which assigns the proper character to the individual grid elements and packs the codes 8 to a word. Upon return to the main program, the character array is printed out in strips due to the limitations in width of a printer carriage. Top of the page skipping is suppressed during each strip, and the strips are numbered. Cycling is controlled by the information of the title cards, that is a title card designates that an input grid follows, an END card designates that new parameter cards are to be read, and a FINISH card designates the program has been completed.

OVERPRINTING

Another version of program CHRDSPLY, called CHROVER, will overprint characters. This program is used similarly to CHRDSPLY with these differences;

1. In column 32 of the main control card the number of overprint character sets is punched. This number must be between 1 and 9, therefore allowing up to 10 characters per data intervel to be superimposed on each other.

2. Instead of a single set of BCD characters or octal codes, as in CHRDSPLY, the main set plus the overprint sets must be punched, all using the same format. All sets must be in the same mode.

   Note: If a single character is desired its corresponding overprint characters should be blank.

3. Size limits: (((NC-1)/8 + 1)xNR) x (Number of character sets*) cannot exceed 4000.
   NCxNR cannot exceed 32000.

4. Warning: This program is more time consuming than CHRDSPLY and its use could possibly result in bitter operators. Also a number of overprints per line tends to punch holes in paper.

*Number of character sets = number of overprint sets + 1

Program : ATSDSPLY

Language : F-63/Compass

Computer : 3600

Programmer: Eric A. Smith

Date : June 21, 1967

Purpose : This program is an ATS character display program with the same setup as CHRDSPLY using ATSIN as the input subroutine.

Usage : The program is used in the same manner as CHRDSPLY except for the call to the input subroutine. The program calls ATINSTUP after reading all of its own control cards. The call to INPUT is replaced by a call to ATSIN.

Method : The methods can be found in the CHRDSPLY and ATSIN with write-ups.

Program : SSCONTUR

Language : F-63/Compass

Computer : 3600

Programmer: Eric A. Smith

Date : July 21, 1967

Purpose : This program is a generalized contouring program designed to allow the user to specify the horizontal and vertical projection, and the contour levels. The contour map is outputted on the calcomp plotter with the individual contour lines labeled if requested.

Usage : The program requires that the user write his own input subroutine. The program calls this routine with a CALL INPUT (IDIMI,IDIM2,GRID) statement, where IDIMI = the number of columns and IDIM2 = the number of rows (these are read in prior to the call as will be explained) of the input area GRID. Since GRID is a linear array, the subroutine must make provisions for storing the elements in the standard linear format, i.e., row wise. After the input routine is prepared, the subroutine deck should be placed in the program deck, following 3600 program order rules. If this subroutine requires the reading of its own control cards, note that they must be positioned so as not to interfere with the main control cards (see below). The program is set up to process a series of input grids under one set of parameters and requires a set of parameters for each series processed. The following parameters are required:

col 1-3: number of columns ($2 \leq NC \leq 200$)

col 4-6: number of rows ($2 \leq NR \leq 200$)

Limitations: NC x NR cannot exceed 16,000

col 7-12: width of contour map (F6.3 format; this is the X distance on the plotter; $0 < P1 \leq 163.83$); if this parameter is blank or out of limits, it will be set to 10

col 13-18: height of contour map (F6.3 format; this is the Y distance on the plotter; $0 < P2 \leq 10.5$); if this parameter is blank or out of limits, it will be set to 10

col 19-20: number of contour levels ($1 \leq NCL \leq 48$); if this parameter is blank or out of limits, it will be set to 5 col 21: 0 or blank specifies that uniform contour levels will be used requiring the specification of the following two parameters.

1 specifies that non-uniform contour levels will be used, requiring the reading of (a) contour levels card(s).

2 specifies that the program will set up the desired number of contour levels with their values based on the maximum and minimum values in the grid.

col 22-31: if col 21 is 0 or blank, this parameter specifies the minimum contour level, otherwise leave blank (uses a F10.4 format)

col 32-41: if col 21 is 0 or blank, this parameter specifies the uniform spacing between the contour levels, otherwise leave blank (uses a F10.4 format)

col 42: 0 or blank specifies that the horizontal grid spacing (spacing between columns) is uniform and will be calculated from the grid column dimension and the contour map width.

1 specifies that the horizontal grid spacing is non-uniform and will be read in on (a) horizontal grid spacing cards(s).

col 43: 0 or blank specifies that the vertical grid spacing (spacing between rows) is uniform and will be calculated from the grid row dimension and contour map height.

1 specifies that the vertical grid spacing is non-uniform and will be read in on (a) vertical grid spacing card(s).

col 44-49: this is the critical distance such that if the distance between two consecutive points exceeds this value, other points will be added to smooth the curve; this value also determines the number of points added; the suggested value for most curves is .1 (use a F6.4 format; $0<CD<99999.$); if this parameter is blank or out of limits it will be set to .1

col 50: 0 or blank specifies that contour line labeling (contour value) will be used requiring the specification of the following two parameters.

1 specifies that labeling will not be used.

col 51-56: desired size (height) of contour labels (use a F6.4 format; $0<H\leq 1$; if this parameter is blank or out of limits it will be set to .14

col 57-62: 4-6 character floating point format field of the form Fxx.yy specifying the format of the contour line labels (which are the contour levels themselves), e.g., if the contour levels range from 0.25 to 0.75 the format must read F4.2. This field must not be left blank if labeling is desired; this parameter must be left justified.

col 63-64: plotter tape logical unit number; if $1 \leq LUN \leq 49$ the user must supply his own tape; if this value is out of range or left blank it will take on the value 62, i.e., the Scope system unit for plotter tape.

col 65: 0 or blank if contour smoothing is desired
1 if contour smoothing is not desired

NOTE: for values other than those specified for parameters 6, 9, 10, 12 and 16, the parameter will be set to 1.

Contour level card (use only if col 21 is 1)
This (these) card(s) contain(s) in an 8F10.4 format the desired contour levels (col 19-20) in ascending order.

Horizontal grid spacing card (use only if col 42 is 1)
This (these) card(s) contain(s) in an 8F10.4 format the desired spacings between columns starting from the left of the map. Note that the first spacing is measured between the map border and the first column and the last spacing is measured between the final two columns, thus yielding the same number of spacings as there are columns.

Vertical grid spacing (use only if col 43 is 1)
This (these) card(s) contain(s) in an 8F10.4 format the desired spacings between rows starting from the bottom of the map. Note that the first spacing is measured between the map border and the bottom row and the last spacing is measured between the two topmost rows, thus yielding the same number of spacings as there are rows.

After these parameters are read in, a series of input grids may be processed. Preceding each call to the input routine, an 80 column alphanumeric title card must be read in. This information is used as a title for the contour map associated with that input. If new parameters are desired, a card with the word END in the first 3 columns follows the first group of data input. This procedure may continue with no limitations. However, the final group must be followed by a card with the word FINISH in the first 6 columns. This indicates the run is complete. The user should take precautions to position any control cards read in by his input routine so as not to interfere with the program control and title cards.

The output will be produced on the calcomp plotter, as a map of the size specified on the control cards and with the title information printed below the map.

Program : ATSCNTUR

Language : F-63/Compass

Computer : 3600

Programmer: Eric A. Smith

Date : June 21, 1967

Purpose : This program is an ATS contour plotting program with the same setup as SSCONTUR except for the call to the input subroutine. The program calls ATINSTUP after reading all of its own control cards. The call to INPUT is replaced by a call to ATSIN.

Method : The methods can be found in the SSCONTUR and ATSIN write-ups.

Program : ATSFETUR

Language : F-63/Compass

Computer : 3600

Programmer: Eric A. Smith

Date : August 31, 1967

Purpose : This program analyzes user selected regions of an ATS line signal. A region for our purposes is defined as an intervel of the scan line where the slope of a linear least squares fit through the region is less than the "critical slope". The "critical slope" is a function of 4 variables which will later be explained in the Method section. The user has control over the "critical slope" by the use of program parameters. Essentially, the line is divided into regions satisfying the specified conditions and these regions have their mean, variance, and standard deviation computed. By the use of another parameter, regions falling below a minimum region size are ignored. A last parameter determines a uniform section size that the regions are furthur broken down into. When this occurs the individual sections have their statistics computed, but not the total region. The information is output as a table consisting of 3 different measures; those areas of the signal not within the regions are referred to as boundries; rejected regions are referred to as holes; regions or sections of regions are referred to as clouds. As the line is scanned from left to right this information is progressivly recorded along with an element count for each measure. The accepted regions are numbered and within each region the individual sections are numbered.

The records are read by ATSIN and may be contracted or expanded by the use of ATSIN subroutine parameters. There are some minor changes in the use of ATSIN for this program as will be explained.

Usage : This program is set up to process a series of ATS records under one set of parameters with the provision of reinitiating for the second series and so on. The following parameters are required on a control card.

Col. 1-4: line dimension (line length after expansion, contraction, or normal input) $1 < IDIM1 \leq 32000$

The following parameters will be explained in the method section.

Col. 5-8: number of samples averaged
Col. 9-12: number of samples skipped
Col. 13-16: boundry determinator difference
Col. 17-20: consecutive differences needed
Col. 21-24: minimum sample section
Col. 25-28: maximum sample section

After this card is read, the program call ATINSTUP. The program has set IDIM2 to 1 and IDIM12 to IDIM1. The program required that the matrix of lines to be processed cannot have a column dimension greater than 1 and is set accordingly. Thus the user may ignore col. 13-16 on the ATSIN control card.

After these parameters are read in, a series of input lines may be processed. Preceeding each call to ATSIN, an 80 column alphanumeric title card must be read in. This information is used as a title for the table associated with the line. If new parameters are desired, a card with the word END in the first 3 columns follows the first group of title cards. This procedure may continue with no limitations. However, the final group must be followed by a card with the word FINISH in the first 6 columns. This indicates the run is completed.

Program : ATSPLOT

Language : F-63/Compass

Computer : 3600

Programmer: Eric A. Smith

Date : August 16, 1967

Purpose : This program plots ATS records on the calcomp plotter. The records are read by ATSIN and may be contracted or expanded by the use of the various parameters. There are some minor changes in the use of ATSIN for this program.

Usage : This program is set up to process a series of ATS records under one set of parameters with the provision of reinitiating for the second series and so on. The following parameters are required on a control card.

Col. 1-4: line dimension (line length after expansion, contraction, or normal input)
$1 < IDIM1 \leq 32000$

Col. 5-6: plotter tape logical unit number; if $1 \leq LUN \leq 49$ the user must supply his own tape; if this value is out of range or left blank, it will take on the value 62, i.e., the Scope system unit for plotter tape

After this card is read in the program calls ATINSTUP. The program has set IDIM2 to 1 and IDIM12 to IDIM1. The program requires that the matrix of lines to be processed cannot have a column dimension greater than 1 and is set accordingly. Thus the user may ignore col. 13-16 on the ATSIN control card. Also if the user is reading in punched binary lines by the use of a 1 in column 22, he must include on the ATSIN control card the starting element in col. 9-12 and the two parameters in col. 24 and col. 25-28 associated with that line. These must be specified for plotting purposes.

After these parameters are read in, a series of input lines may be processed. Preceding each call to ATSIN,an 80 column alphanumeric title card must be read in. This information is used as a title for the plot associated with that line. If new parameters are desired, a card with the word END in the first 3 columns follows the first group of title cards. This procedure may continue with no limitations. However, the final group must be followed by a card with the word FINISH in the first 6 columns. This indicates the run is completed.

The plot will be produced on the calcomp plotter as a 10" by 72" map.

Program : CLOUDPOP

Language : F-63/Compass

Computer : 3600

Programmer: Eric A. Smith

Date : August 25, 1967

Purpose : This is an "ATS-B picture" cloud consensus and statistics program. The information computed consists of the following; a map of cloud boundries based on upper and lower thresholds; an information table associated with the individual clouds on the map; frequency distributions for cloud size, cloud mean brightness, and picture element brightness; the percent of total cloud cover; and the mean picture brightness. The cloud map is output on the calcomp plotter and consists of the individual cloud borders and an index number which can be looked up in the information table. There are two indexing systems. The first is for clouds that are seven or less elements in size. These clouds are numbered with the natural numbers beginning with one in the order that they are found by scaning the picture grid. These clouds will be listed at the front of the information table. All clouds of larger size are indexed with the second system which again uses the same numbers but follows them with an asterick. These clouds will be listed in the latter portion of the table. An explanation of why this technique is used will be found in the Method section. The information table consists of five "cloud characteristics" headings; cloud size (measured in elements); cloud percent of picture (by size); cloud mean brightness; cloud brightness center; and cloud geometric center. The other information is optional and when requested will be both printed and plotted.

Usage : The following parameters are required on a control card;

Col. 1-3: number of columns ($2 \leq NC \leq 7200$)
Col. 4-6: number of rows ($2 \leq NR \leq 2000$)
Limitations: NC x NR cannot exceed 16,000
Col. 7-12: approximate east-west distance of the picture elements under analysis (if $EWD \leq 0.0$, then EWD = 2.0; use an F6.2 format)
Col. 13-18: approximate north-south distance of the picture elements under analysis (if $NSD \leq 0.0$ then NSD = 2.0; use an F6.2 format)
Col. 19-24: lower cloud threshold (if $LCT < 0.0$ then LCT = 25.0; use an F6.2 format)
Col. 25-30: upper cloud threshold (if $UCT < 256.0$ then UCT = 256.0; if $LCT > UCT$ then LCT = 25.0 and UCT = 256.0; use an F6.2 format)

Col. 31: 0 or blank if information tables are not be be punched.

1 if information tables with heading are to be punched.

Col. 32: 0 or blank specifies that the cloud size intervels are uniform; this method requires the following three parameters

1 specifies that the cloud size intervals are non-uniform; this method requires the following parameter and (a) cloud size intervels card(s).

2 specifies that a cloud size frequency distribution will not be calculated.

Col. 33-35: specifies the number of cloud size intervels ($2 \leq N \leq 257$); leave blank if col 32 is 2.

Col. 36-41: If column 32 is 0 or blank this parameter specifies a fixed point number which is the upper bound of the first interval (use an I6 format).

Col. 42-47: If column 32 is 0 or blank this parameter specifies a fixed point number which is the size of the uniform intervals (use an I6 format). Note that the first and last intervals are not necessairly equivalent to the specified interval size. This is because the interval bounds are computed by a recursive adding of the interval size to the initial upper bound, and ending with the computation of the upper bound of the next to the last interval. Since the first interval has no lower bound specified, and the last interval has no upper bound computed, these two intervals are, in a sense, open ended.

Col. 48: 0 or blank specifies that the element brightness intervels are uniform; this method requires the following three parameters.

1 specifies that the element brightness intervals are non-uniform; this method requires the following parameter and (a) element brightness intervals control cards(s).

2 specifies that an element brightness frequency distribution will not be calculated.

Col. 49-51: specifies the number of element brightness intervals ($2 \leq N \leq 257$); leave blank if col. 48 is 2.

Col. 52-57: If column 48 is 0 or blank this parameter specifies a floating point number which is the upper bound of the first interval (use an F6.2 format).

Col. 58-63: If column 48 is 0 or blank this parameter specifies a floating point number which is the size of the uniform intervals (use an F6.2 format). See explanation for parameter in Col. 41-46.

Col. 64: 0 or blank specifies that the cloud mean brightness intervals are uniform; this method requires the following three parameters.

1 specifies that the cloud mean brightness intervals are non-uniform; this method requires the following parameter and (a) cloud mean brightness intervals control cards(s).

2 specifies that a cloud mean brightness frequency distribution will not be calculated.

Col. 65-67: specifies the number of cloud mean brightness intervals ($2 \leq N \leq 257$); leave blank if col 64 is 2.

Col. 68-73: If col. 64 is 0 or blank this parameter specifies a floating point number which is the upper bound of the first interval (use an F6.2 format).

Col. 74-79: If col. 64 is 0 or blank this parameter specifies a floating point number which is the size of the uniform intervals (use an F6.2 format). See explanation for parameter in col. 41-46.

Col. 80: Specifies the number of cloud threshold cases tried on each grid: If only the initial thresholds are to be used leave this column blank. If 1 or more furthur cases are desired, cloud threshold cards must be punched. Each card will contain a pair of minimum and maximum threshold values in a 2F6.2 format, following the cloud threshold restrictions used with the main control card. These cards are placed after the title cards (see below). Since this program uses the ATSIN input routine, sets of cloud threshold cards must be placed after each title card for a given grid matrix (the program resets the thresholds to their initial values for each new grid).

Second Control Card (Optional):

If column 32 of the first control card contains a 1 punch, this card contains the n-1 upper bounds for the n specified intervels (see explanation of uniform intervals). This card allows non-uniform cloud size intervals to be chosen (use a 8I10 format; use extra cards if necessary).

Third Control Card (Optional):

If column 48 of the first control card contains a 1 punch, this card contains the n-1 upper bounds for the n specified intervals (see explanation of uniform intervals). This card allows non-uniform element brightness intervals to be chosen (use a 8F10.4 format; use extra cards if necessary).

Fourth Control Card (Optional):

If column 64 of the first control card contains a 1 punch, this card contains the n-1 upper bounds for the n specified intervals (see explanation of uniform intervals). This card allows non-uniform cloud mean brightness intervals to be chosen (use a 8F10.4 format; use extra cards if necessary).

After these control cards are read, the program calls ATINSTUP requiring the ATSIN control card. After this card is read, a series of input grids may be processed. Preceding each call to ATSIN, an 80 column alphanumeric title card must be read. This information is used to title the information table. If new control parameters are desired, a card with the word END in the first three columns follows the first group of data input. This procedure may continue with no limitations, however, the final group must be followed by a card with the word FINISH in the first 6 columms, which indicates the run is complete. The user should recall that cloud threshold cards for extra cases, follow each title card within a group, if that option is desired.

Subroutine: ATSIN

Language : F-63/Compass

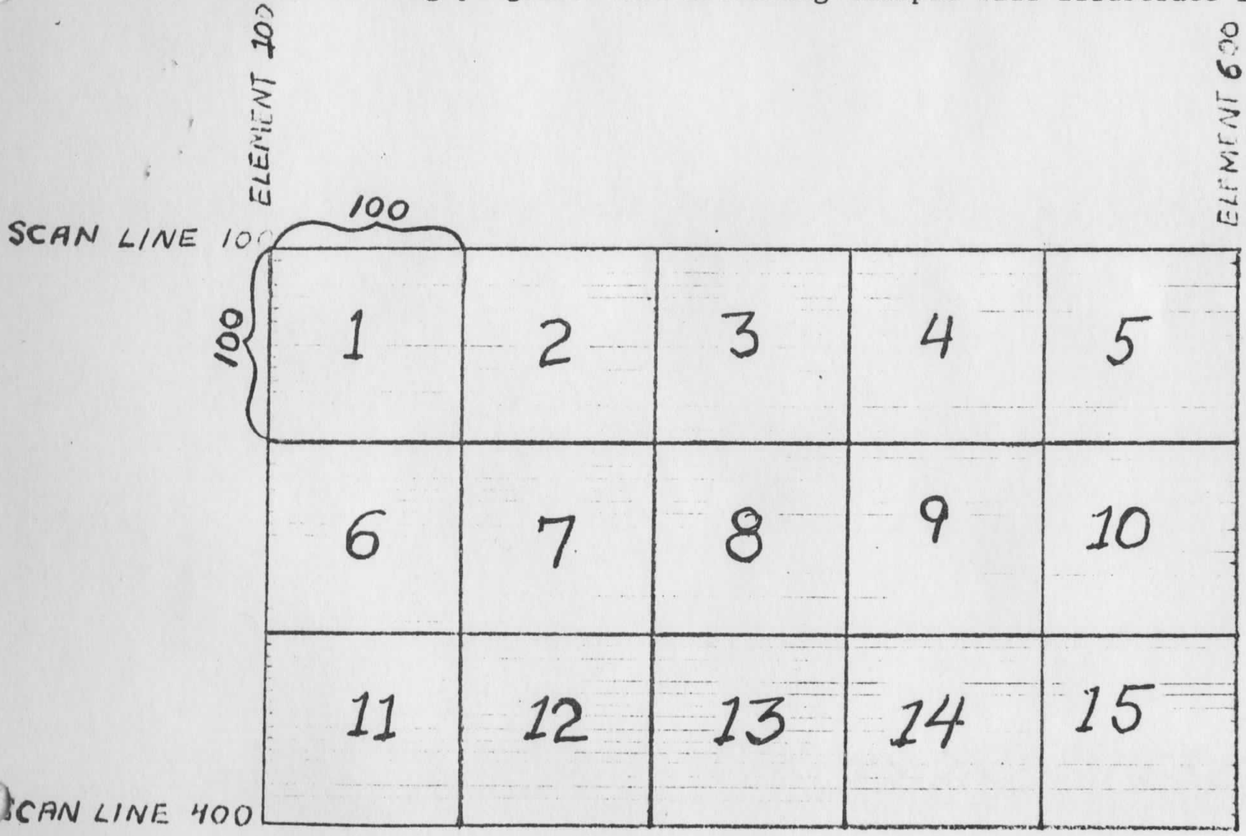
Computer : 3600

Programmer: Eric A. Smith

Date : June 12, 1967

Purpose : This is a general ATS-B input subroutine directed toward those programs requiring the input of rectangular grids for analysis. The input tape required is an ATS-B edited tape (created from MENAGE) with six 8-bit picture elements packed to one 48-bit computer word. The subroutine unpacks the data and stores a rectangular grid in a linear array.

Usage : There are two entry points to the subroutine, one of which reads a parameter card and sets the necessary parameters in the second entry or main part of the subroutine. The function of the routine is to input a matrix of uniform rectangular grids which themselves form a rectangle; each grid of the matrix being input on a separate call to the subroutine. The user must define the upper left hand corner of the matrix; the dimensions of the matrix; along with the dimensions of the matrix elements. A matrix element is simply a grid (picture elements by scan lines) which is to be analyzed by the calling program. The following example will illustrate its use.



A series of 100 by 100 size grids are to be input on separate calls to the subroutine. There are 15 such grids which form a 5 by 3 matrix of grids. The upper left hand corner of the matrix (complete rectangle) is located at line 100, 100 elements over from the left of the picture file block. The order in which each of the grids is input is shown by the numbering on the illustration, i.e., rowwise. Therefore to completely process the area, 15 separate calls have to be made to the subroutine along with an initial call to set up parameters.

The calling sequence for initial setting up of parameters is as follows:

CALL ATINSTUP(IDIM1,IDIM2,IDIM12, GRID); these paramters are discussed below. Also a paramter card is read in with the following information:

Col. 1-4: File number of data area

Col. 5-8: Top Scan Line of data area

Col. 9-12: Starting element (measured from left of picture file block)

Col. 13-16: Column dimension of grid matrix

Col. 17-20: Row dimension of grid matrix

Col. 21: 0 or blank if printing of the grids is not desired

1 if printing of the grids is desired

Col. 22: 0 or blank if input grids are not read as binary decks

1 if an input grid is read as a binary deck

Note: If a binary deck is read, a call to the main entry point is still required however none of the other setup parameters are relevent; the call to ATINSTUP only initiates the routine for a single call; there is no tape movement involved if this option is used

Col. 23: 0 or blank if punching out grids as binary decks is not desired

1 if punching out grids as binary decks is desired

Note: a request for binary punched grids will punch the complete matrix of grids in rowwise order; refer to GET and PUT writeup on punched binary decks

Col 24: 0 or blank specifies normal element input

1 specifies that after each element of an input line the parameter specified in col. 29-34 will be inserted the number of times specified by the parameter in col. 25-28; thus the grid columns are expanded; Note that the column dimension must specify the exact column dimension <u>after</u> the input line is expanded; the number of required elements read is calculated by dividing the column dimension by the following paramter plus 1

2 specifies that after each element of an input line, that particular element is repeated the number of times specified in the following paramter; the same dimensioning rules as above apply to this case

3 specifies that after each element of an input line, the number of elements specified in the following parameter is averaged along with that particular element; thus the grid columns are contracted; Note again that the column dimension must specify the exact column dimension <u>after</u> the input line is contracted; The number of required elements read is calculated by multiplying the column dimension by the following parameter plus 1

4 specifies that after each element of an input line the number of elements specified in the following parameter will be discarded (a sampling effect); the dimensioning procedure is the same as in the case of element averaging

Col.25-28: This specification depends on which case is being used in col. 24

Col.29-34: If col. 24 is 1, this parameter specifies the value to be inserted between elements; if col. 24 is not 1, leave blank (use a F6.2 format)

Col. 35: 0 or blank specifies normal line input

1 specifies that after each grid row, rows containing the parameter specified in col. 40-45 will be repeated the number of times specified by the parameter in col. 36-39; Thus the grid rows are expanded; Note that the row dimension must specify the exact row dimension <u>after</u> the grid rows are expanded; The number of required input lines is calculated by dividing the row dimension by the following parameter plus 1

2 specifies that after each grid row, that particular row is repeated the number of times specified in the following parameter; the same dimensioning rules as above apply to this case

3 specifies that after each grid row, the number of grid rows specified in the following parameter is averaged along with that particular grid row (by columns); Thus the grid rows are contracted; Note again that the row dimension must specify the exact row dimension after the grid rows are contracted; the number of required input lines is calculated by multiplying the row dimension by the following parameter plus 1

4 specifies that after each grid row, the number of grid rows specified in the following parameter are discarded (a line sampling effect); the dimensioning procedure is the same as in the case of line averaging

Col.36-39: This specification depends on which case is being used in col. 35

Col.40-45: If col. 35 is 1, this parameter specifies the value to be used in inserted grid rows; if col. 35 is not 1, leave blank (use a F6.2 format)

After this card is read the tape is then positioned at the starting line of the number one grid and parameters for the main entry are established. Next the subroutine must be called through its main entry the exact number of times that there are grids in the matrix. The user may choose to ignore the individual grids or he may analyze them, but in order to properly reference the next data area all calls must be completed. The incoming grids, as stated, are sequenced row wise.

The main entry point calling sequence is as follows:

CALL ATSIN(IDIM1,IDIM2,IDIM12,GRID) were IDIM1 - longitidudinal dimension of the individuals grids; IDIM2 = latitudinal dimension of the individual grids; IDIM12 = product of IDIM1 and IDIM2 (this is used as the dimension for the array GRID); GRID = array into which the grid is read, one picture element per word. Note that GRID is a linear array in the subroutine, the data being read in row wise. The user should also note that in processing a series of data areas, the sequence of files accessed must be in ascending order. The subroutine requires the data tape to be assigned to logical unit number 1.

Note on Dimension Limitations: The dimension limitations explained in this writeup apply only to normal input (no expansion or contraction of lines or elements). In the case of element sampling or averaging or line averaging, it is possible to overflow bounds while still adhering to the dimensioning rules. The reason for this is fairly obvious. For example, in the case of averaging, extra elements or lines are required to be read above and beyond the specified dimensions. Therefore, it is up to the user to calculate the required space for a particular contraction process and then set the dimensions. A verbal explanation may be required of the programmer if this explanation is insufficient.

MEMO October 6, 1967

To: ATS Digital Data Users

From: T. Vonder Haar

Re: Preliminary Outline of Procedures to be followed in Requesting Programming Assistance

1. All ATS-1 digital data tapes are received, logged and copied by the Analysis and Data Processing Section of the Space Science and Engineering Center. In addition to these duties, this same group has developed many related programs to provide supporting information and to display the ATS-1 digital data.

2. At this time, all data users fall into two groups:
   a) graduate students who have already established "credit" at SSEC through work agreement #1011 between Professor Suomi and SSEC.
   b) all other users

3. Type "a" users should follow these procedures:
   3.1 Be sure Professor Suomi knows of your current plans to use ATS digital data.
   3.2 Contact Jean Anderson, Manager of the Analysis and Data Processing Section, to obtain an estimate of the amount of programmer time and machine time you will need.[1]
   3.3 Prepare a memo to the Principal Investigator of your grant or contract asking his authorization for the estimated expenditures.
   3.4 Give Jean Anderson the signed memo and she will assign a programmer to work with you.

4. All other users should:
   4.1 Contact Mr. Elton Waack of SSEC for information about establishing "credit" at the Center.
   4.2 Follow procedures 3.2 through 3.4.

Tom VonderHaar

Approved: V. E. Suomi [signature]

V. E. Suomi

---

[1] Note that the normal procedure is to pay for programmer manhours by transferring funds from your department to SSEC and to pay for machine time through your department by using your UWCC card.

"NAVIGATION" PROBLEMS AND THE DIGITAL DATA

In Section 2 the line by element array in which digital data are stored has been discussed. "Navigation" of the digital data essentially requires the conversion from this array to one of latitude and longitude, and vice versa. Such a conversion is hindered because the satellite attitude departs slightly from the ideal case. A description of this problem inherent to all the ATS data has been discussed by Hanson, Vonder Haar and Nicholson. The SSEC has already done a large amount of work both on the problem of "navigating" the digital data and also on the usefulness of digital data for attacking the general navigation problem. Reports on all of these efforts will be distributed.

RESEARCH PROJECTS USING ATS DIGITAL DATA

This section is an attempt to summarize briefly some of the work planned or now underway that uses digital data. Because of the extensive hardwave and softwave development that was necessary, these data are just now beginning to be utilized in scientific projects. A breakdown by organization includes.

a) NESC - the programming section under C. Bristor has applied their experience and techniques developed for handling ESSA digital data to some of the ATS values. Most of their work thus far has been on the quality control aspects of the problem and in the area of rapid display using a video output device. They do have some plans for more scientific projects.

b) NASA-(GSFC) - Bandeen and Raschke are now using one day of ATS digital data to obtain information about the bi-directional reflectance properties of clouds. This information will be used as a check on some empirical relationships they have assembled.

c) U of W - Smith and Vonder Haar are developing general display techniques (see Section 4) and have planned a "census" of convective cloud size and brightness. Together with Dr. C. Murino they have done some preliminary work on the problem of determining cloud displacements. Hanson and Vonder Haar are examining the information content of the digital data (its areal resolution, brightness resolution, "noise" content, etc.) for meteorological applications by examining a variety of physical situations. Hanson is using ATS data and extensive ground calibration data to "calibrate" the digital numbers in terms of the effective reflected spectral radiance received by the instrument. Cox may use some ATS data to compare with ground observations of solar radiation made during the Line Islands Experiment. Levanon plans to use digital data as part of his study of "sun glitter" and its relation to surface wind.

Inventory of ATS-1 Data Problems

Issued October 9, 1967

SSEC - A & DP

1. Shipped without containers.

   Duration: April 1, 1967 to May 1, 1967

   See memo of C. L. Bristor dated May 8, 1967. 180 tapes were shipped without canisters or tape seal for protection. These tapes may be physically damaged and all are somewhat dirty which will cause parity errors and read problems.

   WARNING

   Shipping of the tapes is unsatisfactory about 50% of the time. No care is taken in handling and numerous tapes have come through with their protective canisters broken. This is more of a problem with the increased shipping distances from Mojave. Some tape containers show evidence of having been rained on and in general all show that they have been subjected to rough handling.

   Please Note!

   A severe blow can damage the quality and content of the signal on the tape. Broken canisters mean dirt on the tapes causing the read problems mentioned above.

Inventory of ATS-1 Data Problems

Issued October 9, 1967

SSEC - A & DP

2. Line Count Problems

Duration: March 22, 1967 to present - intermittent

Line counter problems are of various types. Usually these involve the failure of a bit somewhere in the counter with the result depending on which bit is inoperative.

Ex: 24, 25, 24, 25, 28, 29, 28, 29, 32, etc.
80, - - - - - 89, 80 - - - - 89, 100 - - - 109, etc.

Note:

Even if the counter is working perfectly, it can be off by up to 5 lines due to the timing of the telemetry signals.

Inventory of ATS-1 Data Problems

Issued October 9, 1967

SSEC - A & DP

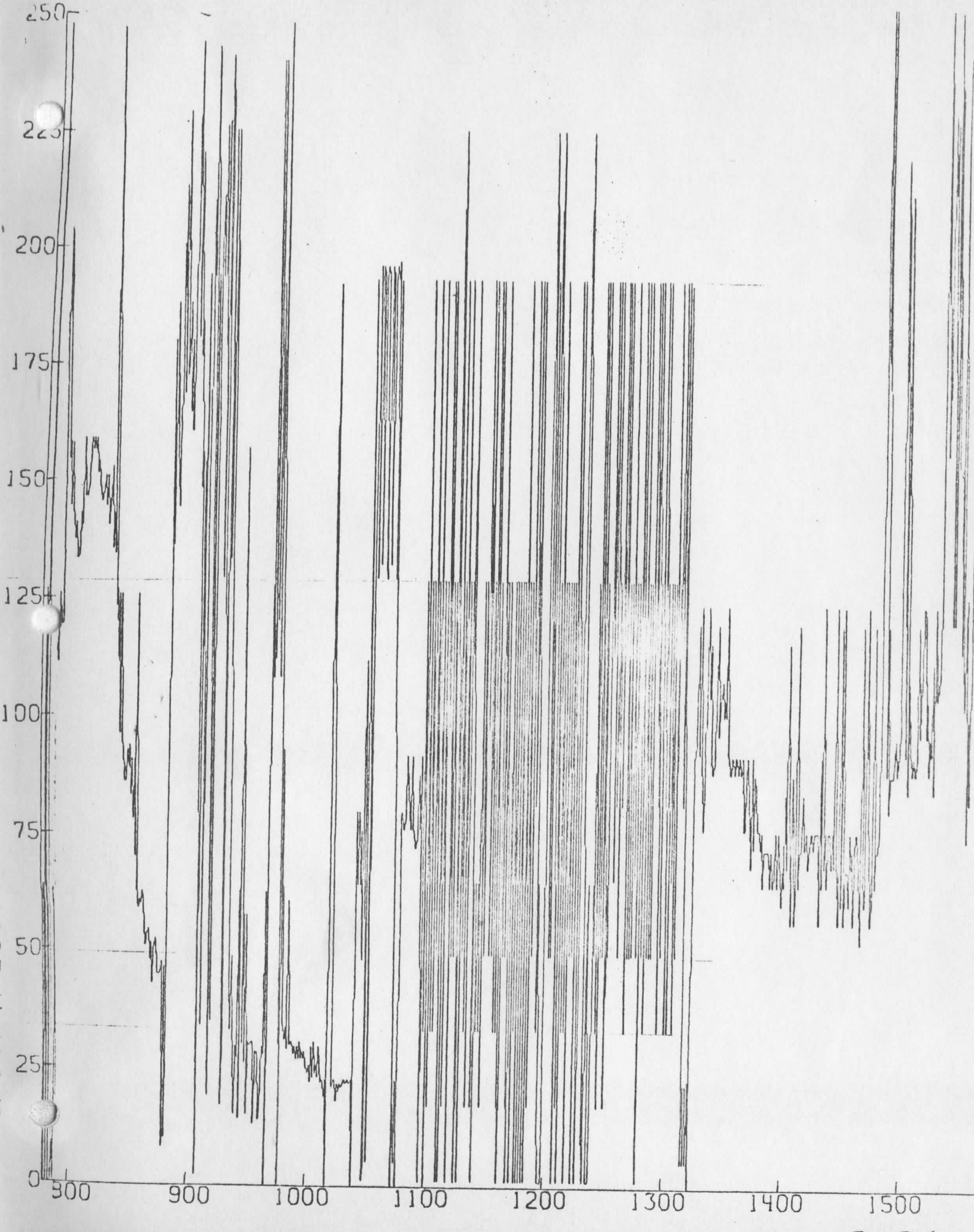
3. A/D Problems

Duration: March 22, 1967 to June 15, 1967

Plots of the frequency of occurance of each digital value suggest a reluctance to rezero the lower count positions when each next higher power of twos position is activated. For example the 63 count (binary 00111111) is over ten times as popular as the 64 count (binary 01000000).

There is a similar pattern between 127 and 128 suggesting that many of the 255 count samples are artifically caused by the 127 count (01111111) refusing to drop to zero when the 128 count (10000000) occurs. See memo of April 26, 1967, by C. L. Bristor.

Figure 3.1 is a portion of a single line plot which shows the effects of this problem on the data.



250
225
200
175
150
125
100
75
50
25
0
800
900
1000
1100
1200
1300
1400
1500

Fig. 3.1

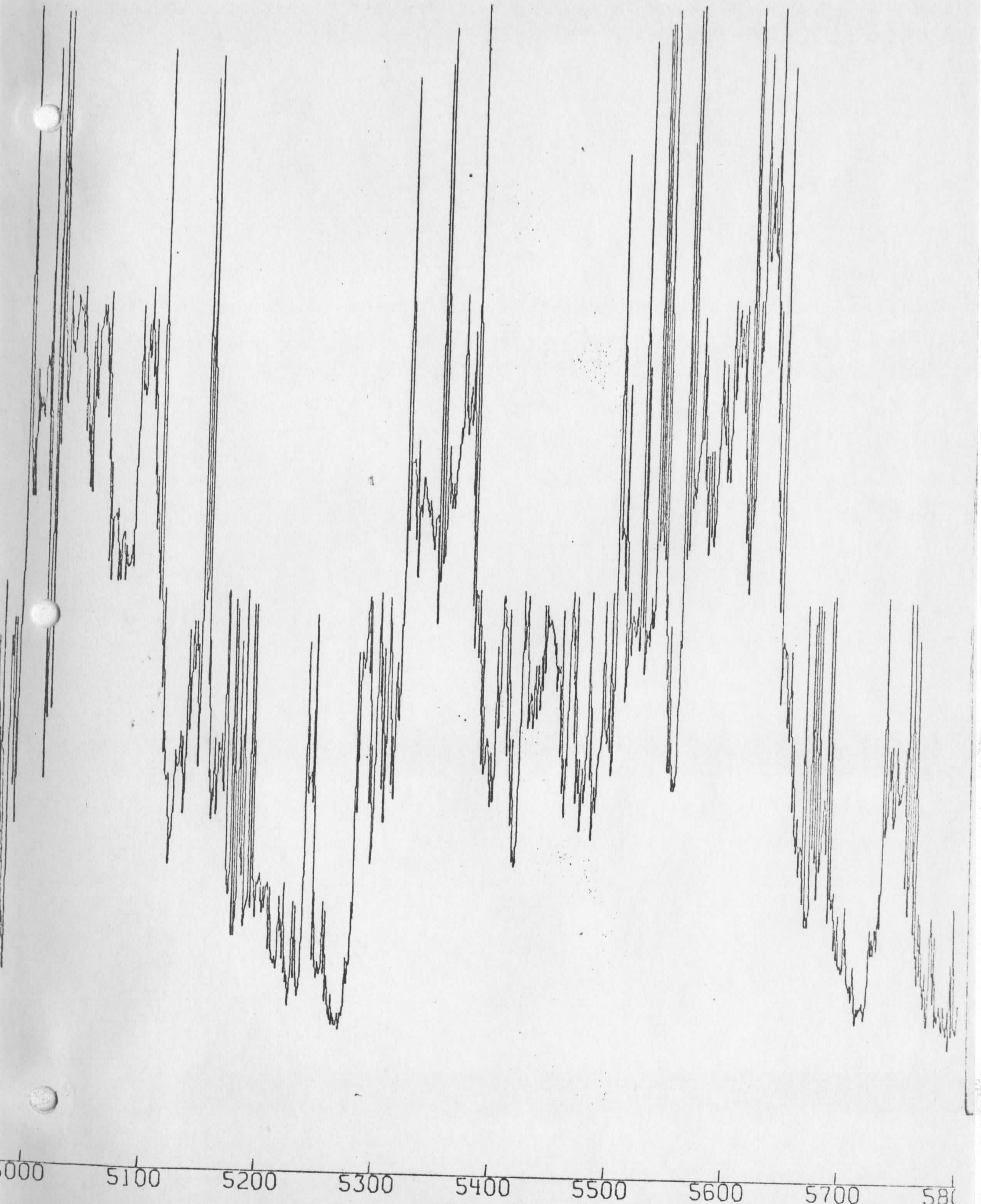


Fig 3.1a

Inventory of ATS-1 Data Problems

Issued October 9, 1967

SSEC - A & DP

4. Reversed Samples

Duration: March 22, 1967 to June 15, 1967

Due to a wiring mistake, the samples were placed on the tape with the samples in each pair reversed, i.e. 2 1 4 3 6 5 etc.

This causes no problem in the computer, but is a scientific consideration in some types of studies. This problem results in fuzzy edges of clouds and horizon when the light and dark samples at a cloud or horizon transition are switched.

Inventory of ATS-1 Data Problems

Issued October 9, 1967

SSEC - A & DP

5. Line Jitter

Duration: March 22, 1967 to present

Due to phase-lock-loop problems caused by the variable spin period of the satellite, the position of the line start varies by $\pm$ 20 samples from a straight line. The attached Figure (5.1) shows the true start line in space compared with the ideal straight line.

This problem results in a wavy horizon and misalignment of corresponding samples from line to line over the picture.

Figure 5.2 shows actual plots of midlines of several sample pictures.

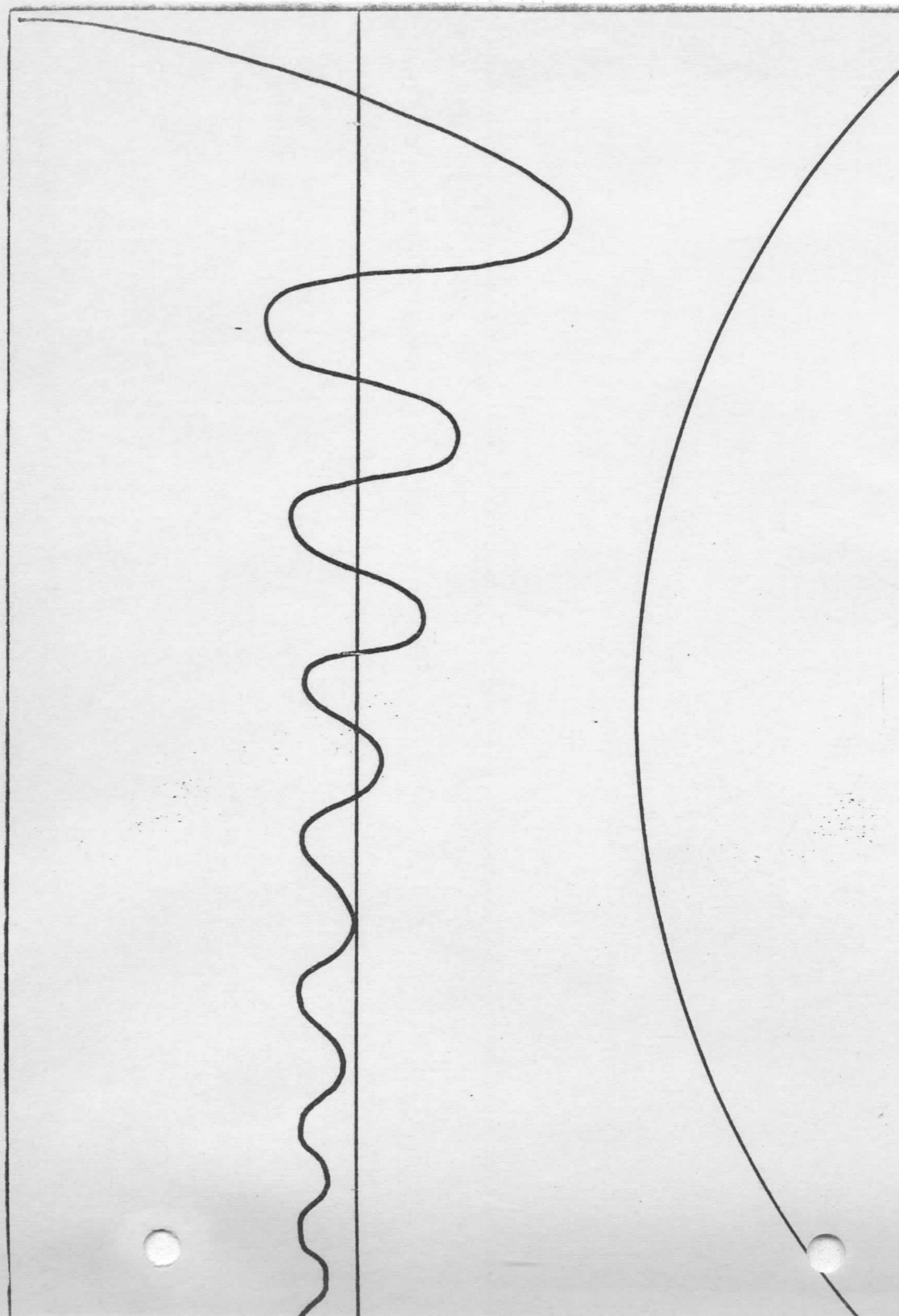


ILLUSTRATION OF

LINE START JITTER

±20 SAMPLES

WAVY LINE SHOWS TRUE LINE START

FIG 5.1

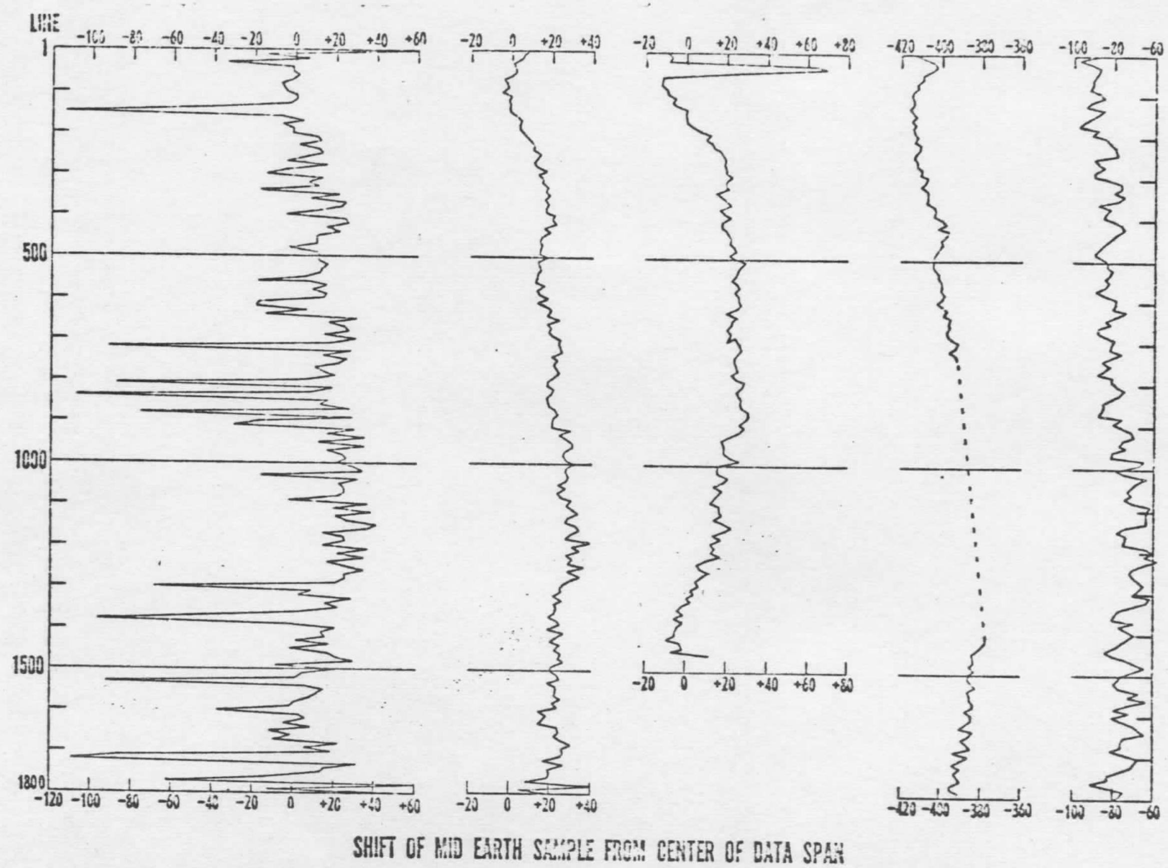

LINE
1
500
1000
1500
1800
SHIFT OF MID EARTH SAMPLE FROM CENTER OF DATA SPAN

FIG. 5.2

Inventory of ATS-1 Data Problems

Issued October 9, 1967

SSEC - A & DP

6. Locked 8-bit

Duration: June 15, 1967, to June 30, 1967

A cable connector problem was responsible for the 8-bit being "on" at all times. This means 8 is added to every value whether or not is should have been. This causes no computer problems, but does cause an analysis problem.

Inventory of ATS-1 Data Problems

Issued October 9, 1967

SSEC - A & DP

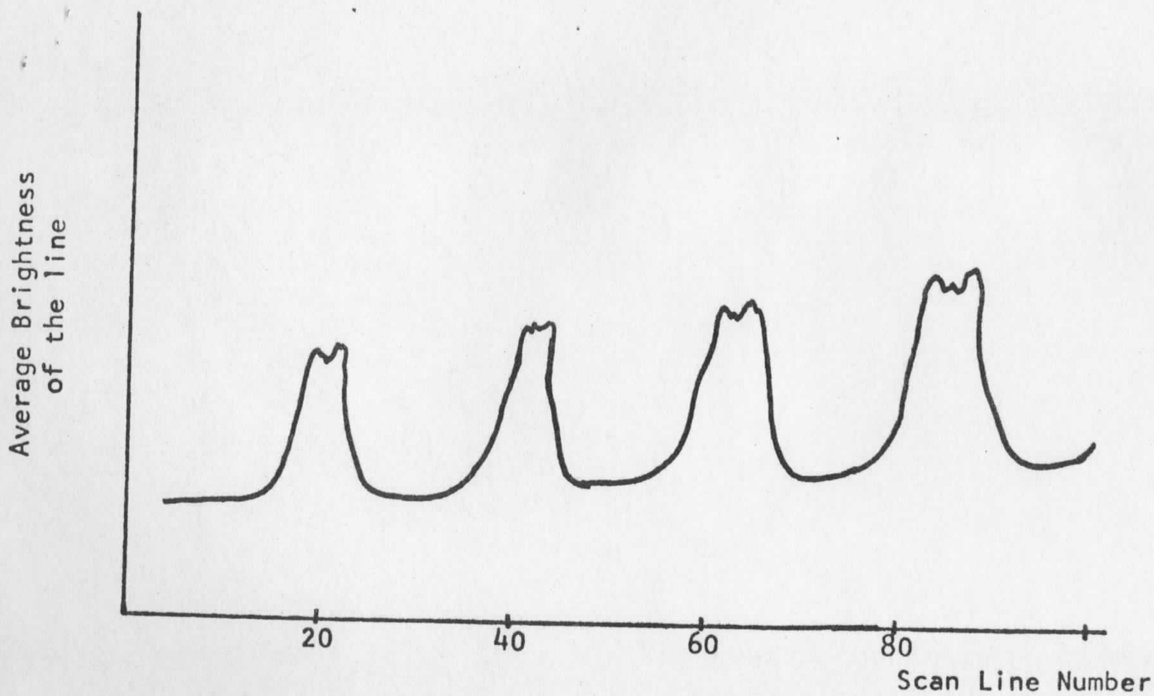
7. VHF Interference

Duration: March 22 to present

The VHF communications experiment aboard the satellite interferes with the camera signal producing unwanted effects.

The sketch below shows how the VHF interference causes an increase in the digital signal level with peaking at 20 line intervals. In the hard-copy prints this can be seen as east - west streakiness which is especially noticable in the space data.

This problem is present on all tapes except some moon shots. It causes no computer input problem, but does interfere with horizon detection and other such level selection programs.



Data for this sketch was taken from the space only data of the moon shots for which the VHF was left on.

Inventory of ATS-1 Data Problems

Issued October 9, 1967

SSEC - A & DP

8. No End-of-File on Tapes

Duration: March 22, 1967, to June 30, 1967 - intermittent

This is strictly a programming problem, but it can be somewhat expensive. Because one picture completely fills a reel of tape some ground station operators would stop the recording when a tape was close to the end and rewind the tape. A computer needs a mark on the tape to signal the end and since this mark was not written on the tapes which were interrupted these tapes are wound completely off their reels in the computer's search for the end-of-file mark. This results in termination of the job and a charge for putting the tape back on its reel.

Inventory of ATS-1 Data Problems

Issued October 9, 1967

SSEC - A & DP

9. No time in line documentation

   Duration: March 22, 1967, to present

   This is a continuing problem since there is no time code generator available for digital recordings.

   This problem is further complicated by the fact that the best estimate of the accuracy of the start time on the official log sheets is ± 30 seconds.

Inventory of ATS-1 Data Problems

Issued October 9, 1967

SSEC - A & DP

10. Tape Crimping

Duration: July 10, 1967 to July 20, 1967

Uneven rewind causes the tapes to skew from side to side on the reel. The edges of the tape are then crushed against the reel making the tape impossible to read.

Some tapes are affected more than others. It is impossible to know for sure if a tape will read without trying it. It is not recommended that data samples be chosen from this period, but any case which is important enough to warrant the expense can be attempted.

Please Note!

Rewind and crimping problems do occur from time to time outside this period. In general these are random occurances affecting single tapes.

Inventory of ATS-1 Data Problems

Issued October 9, 1967

SSEC - A & DP

11. Parity Errors - Low voltage levels

Duration: March 1, 1967 to present

This is a continuing problem with many causes. The major cause is the fact that the original data tapes are made off-line, i.e. by a machine other than a computer, and that they therefore do not measure up to the rigid requirements of the computers which later try to use the data.

Too many parity errors will cause a computer job to terminate in some cases. A low voltage level, improper spacing of characters on the tape or other defect which is seen by the computer as parity errors, sometimes causes extra characters to be read from the tape. This causes misalignment of all data in a record. Tape quality, when these problems are present, can only be checked by trying the tape on one or more tape units. Some tapes read better on one computer than on another.

Inventory of ATS-1 Data Problems

Issued October 9, 1967

SSEC - A & DP

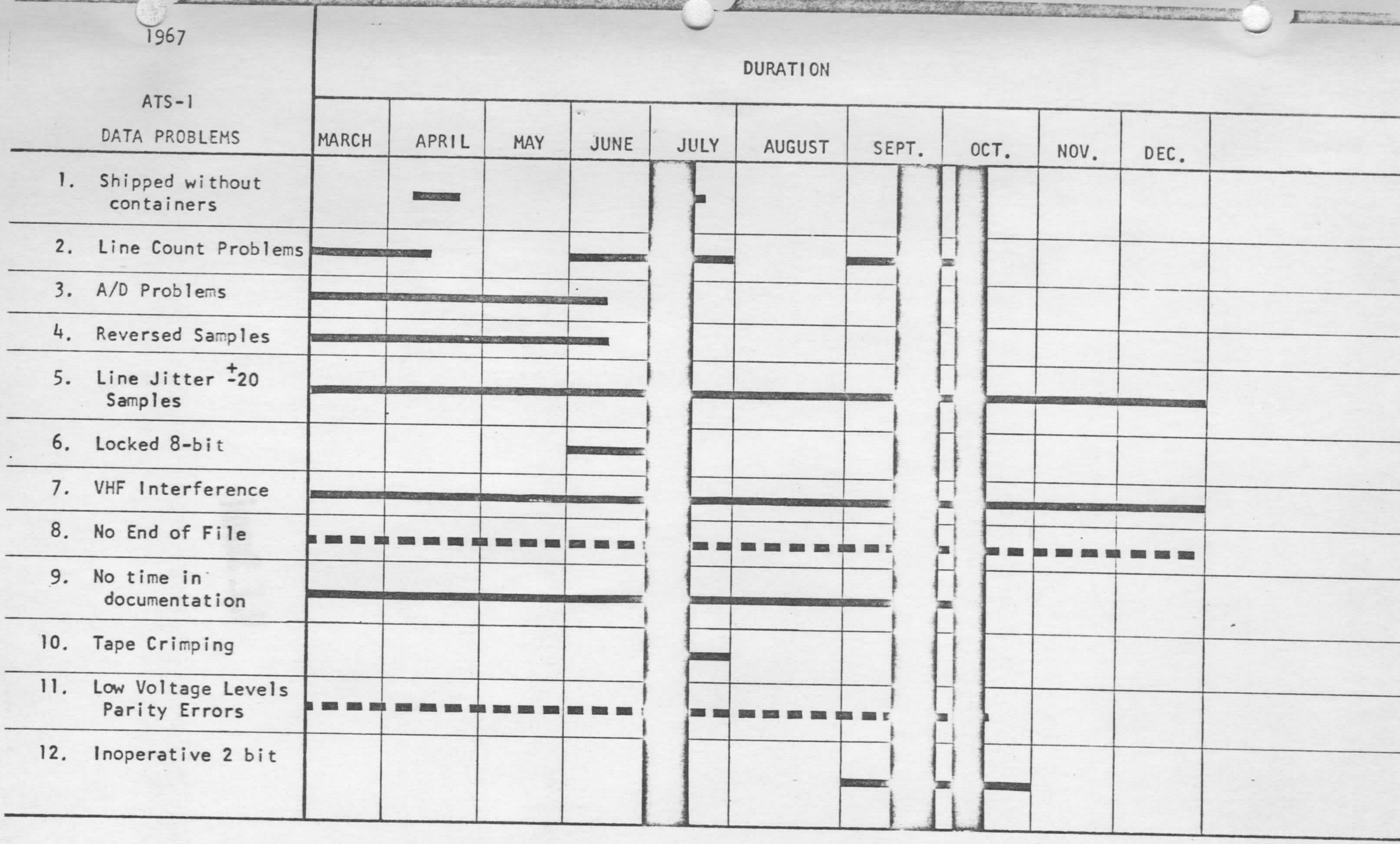
12. Inoperative 2-bit

Duration: September 1, 1967, to present

The 2 bit became inoperative and remained off in all even samples. Even samples are here defined as the lower 8 bits of each 16 bit core word. This was the cause of the line counter problems in September and October. All data from the even side of core will register a count of 2 less than the true value whenever the "2s" position bit should be on. For example, values which should record as 1 through 20 will record as 1, 0, 1, 4, 5, 4, 5, 8, 9, 8, 9, 12, 13, 12, 13, 16, 17, 16, 17, 20. The odd side of core (the left-most 8 bits of each 16 bit core word) is not affected.

Warning:

About the 11th of October, 1967, the circuit card containing the inoperative 2 bit was moved from the even to the odd side of core. From that time to the present, all odd samples have an inoperative 2 bit and the even samples are correct. This was done to remove the bad card from the side of core in which the line count is recorded until a replacement card can be ordered.



Vertical bars indicate periods when NO tapes were made.
DOTTED LINE indicates problem is intermittent.

MLD
10-30-67