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Instruction Manual for the Optronics Digital Image  
Transfer System (ODITS)

by  
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## 1.0 INTRODUCTION

This report consists of sections modified from the operating manual by Optronics International (1981) for the System C-4300. Optronics International, Inc. manufactures sophisticated electro-mechanical devices for transferring digital image data to color and black-and-white film. These systems, such as the Colorwrite (System C-4300) and the Photomation (System P-1700), are controlled by computers working under the Optronics Digital Image Transfer System (ODITS) operating system. Information in this manual that pertains to operations performed in the Remote Sensing Laboratory, Geophysics Branch, Denver, Colorado, of the U.S. Geological Survey has been compiled to provide step-by-step instructions so that relatively untrained operators can successfully perform data transfers and prepare high quality film images. Included are some applications or methods differing from the original manual, that have been found, through use, to work more efficiently for the purposes of the Remote Sensing users. Also discussed are procedures for creating the film factors devised by Duval (1982c) to improve enhancement of film images and for maintaining quality control, Duval (1982c).

### 1.1 Optronics Digital Image Transfer System - ODITS

ODITS was developed with the following objectives in mind:

- Foremost, to provide the user with a straight forward means of plotting images on film.
- Compatibility with both our Photomation Control (PMC) format magnetic tape and LANDSAT band sequential (BSQ) or band interleaved (BIL) tapes.
- Increased transfer speed - ODITS embodies a double-buffered transfer algorithm allowing for concurrent I/O.
- On line transfer characteristics (TC) editing and manipulation will streamline operations.

### 1.2 Loading Procedure

ODITS requires 32K words of memory for proper operation.  
ODITS is loaded from the following media:

#### Floppy Disk

Turn the computer console to "ON".  
Insert ODITS floppy disk in the Ø compartment.  
Sequentially press control buttons on computer console panels as follows:

STOP,  
RESET,  
CLEAR,  
S-REG  
DATA,  
"6",  
SENSE,  
STOP (OFF),  
AUTO,

The following print-out will appear on the terminal:

```
ALPHA/LSI OS (D7)
00:00:00
MM:DD:YY
```

Type the following command:

```
/BA FØ.ODITS
```

When ODITS has been loaded, the user will be asked for the type of OPTRONICS device configured into this system. Type: PM  
Turn the switch on the photomation to "ON". Type: CI  
and wait for the carriage to move to the left stop, after which you will receive a prompt (?).

### 1.3 Devices

In this system, all devices are denoted by a "LET IN=" command. These are the valid devices to be used:

PM	Photomation
KB	Keyboard
WEDGE	Testing function
MØ	Magnetic tape
FØ	Disk storage
F1	Disk storage
BUF	Buffer

### 2.0 COMMAND INTERPRETER

There are two syntactic structures recognized by the interpreter. One is the single command and the other is a command set. A command set is a group of commands enclosed by a pair of angle brackets (<,>). A system command has the following format.

A command is an alphanumeric string defined in the system command dictionary. If a command is to be followed by a parameter field, the command and parameter field must be delimited by a blank character. If not followed by a parameter field; a carriage return, semi-colon, or right angle bracket (under appropriate conditions) are possible command terminators. Some examples are as follows:

TCLIST TCBUF1	(command, parameter field)
LET IN=TK;RUN (CR)	(command, command)
3<LET IN=MØ;RUN>	(command, command)

The parameter field is a string of symbolic or numeric values separated by commas. These values are arguments on which the command will operate. The number and type of parameters allowed is determined by the command which will use them. An example is as follows:

```
TCCOPY TCBUF4,TCBUF7,TCBUF1 (command parameter, parameter,
                             parameter)
```

A command line consists of a single command, a command set or a group of command sets terminated by a carriage return. Several commands may be referenced on one command line by separating each command (including the parameter field) with a semi-colon. Some examples are as follows:

```
LET IN=MØ;RUN (CR)
LET IN=TK;RUN;LET IN=MØ,TC=TCBUF1;RUN
2<LET IN=TK;RUN;LET IN=MØ,TC=TCBUF1;RUN>;LET IN=TK;RUN;LET
IN=MØ,TC=TCBUF2;RUN;REWIND
```

#### Examples of Commands:

- (?) Indicates computer response -
- a) Command to rewind magnetic tape:  
? REW
- b) Command to assign the output device to the plotter and the TC to the first TC buffer.  
? LET OUT=PLOT,TC=TCBUF1
- c) Command to list a histogram to the console excluding all non-occurring values from the output:  
? HGLIST NZ

All commands may be referenced in an abbreviated form starting from the first letter and continuing in order from left to right. There is, however, a potential problem in that an abbreviation, such as TC, might cause TCLIST or TCEDIT to execute. The difference is determined by the order of definition of TCLIST and TCEDIT in the command library; therefore, it is wise to use a unique identifier.

TCL is a unique identifier which would properly designate the TCLIST command.

A command set is a group of commands enclosed by a pair of angle brackets: <,>

The set counter is a number which immediately precedes a left angle bracket. This value indicates the number of times the command set enclosed to the right is to be executed by the interpreter. A set counter of negative one (-1) indicates indefinite repetition.

The contents of the command set may be a single command, a string of commands, a string of command sets, or any combination of the preceding. An example of plotting the same image three times from magtape at 50 mm increments along the x-axis of the plotting drum is as follows:

```
Initially let XO=Ø and YO=Ø.
RUN;REW;2<LET XO=XO+50;RUN;REW>
```

A command line is a string of up to 128 alphanumeric characters terminated by a carriage return. The command line contains the sequence of commands the user wishes to communicate to the system. There are editing capabilities the user can employ while entering commands.

<u>KEY</u>	<u>FUNCTION</u>
DELETE	Deletes previous character.
CONTROL-C	Cancels the current line.
CONTROL-R	Retypes the current command line.
SHIFT-N	Allows line continuation for extended command lines.
ESCAPE	Will cause the interpreter to abort a command sequence currently in execution.

### 3.0 SYSTEM COMMANDS

The following is a list of commands that can be executed by the ODITS system.

#### 3.1 Transfer Commands

LET	The LET command allows the operator to assign values to transfer variables and coordinates.
RUN	The RUN command initiates the transfer execution between the devices assigned to the transfer variables IN and OUT.
CONT	The CONTINUE command allows the user to make multi-volume transfers. If a user wishes to plot an image which resides on two reels of tape, after having plotted the first reel, the user will get an *INPUT END OF MEDIA* message. At this point the user can rewind and switch tapes, type CONT (CR) on terminal and image transfer will continue. Note that CONTINUE has the same type of parameter field as LET and RUN.
ST	The STATUS command allows the user to find the setting of a transfer variable or coordinate. The parameter field of the STATUS command may consist of any of several variables and coordinates. The following list is an example:

```

ST
XS      = 0
XE      = 0
YS      = 0
YE      = 0
XO      = 0
YO      = 0
IN      = M0
OUT     = PLOT
INRAST  = 50
OUTRAST = 50
WINDOW  = NO
TC      = NO
POLARITY = +
HIST    = NO
LEDGE   = 6
TREDGE  = 0
FILTER  = CLEAR
NEXT    = BLUE
KBSCALE = 1
FORMAT  = BSQ
CHANNELS = 3

```

BAND	= 1
PIXCOR	= NO
MODE	= GRAY
HEADER	= NO
CI	= TK
CO	= TY

### 3.2 Transfer Characteristics Commands

TCEDIT	The TCEDIT command will allow the user to create a TC of his own selection.
TCLIST	The TCLIST command requires the name of a TC buffer.
TCAPPLY	The TCAPPLY command requires the names of any two TC buffers followed by a third TC buffer. The action of this command is to apply the second TC buffer to the first and deposit the results of this operation into the third buffer.
TCINVERT	The TCINVERT command requires the name of a TC buffer as a parameter and inverts the data in the buffer to values given by 255-X (X = current values).
TCCOPY	The TCCOPY command requires two parameters; one for the source of the copy, the other for the destination of the copy. There are five entities which TCCOPY recognizes:

- 1) TC RAM Buffers i.e., TCBUF1, TCBUF2 which may function as either source or destination parameters.
- 2) PP Paper tape punch - destination only.
- 3) PR Paper tape reader - source only (PP and PR function with PMC-TC format only).
- 4) FLOPPY DISK FILES - A TC buffer may be copied to or from a floppy disk file. A floppy disk file is referred to by a one to six character alphanumeric file name preceded by F0. or F1.. When copying a TC buffer to floppy disk, the chosen disk file name must not be currently in use on the floppy disk where the write shall take place, since it is illegal to overwrite an existing disk file. The prefixes, F0. and F1. represent disk units zero and one, respectively. When writing on a floppy disk, the "WRITE" light must be turned off on the console (i.e., write enabled).
- 5) M0-TCs may be copied to and from the magtape drive. TCs are copied to magtape as one file containing one 256 byte record. Examples are as follows:

```

TCCOPY TCBUF7,M0 (A TC in computer memory is copied to
magtape M0).
TCCOPY PR,F0.TCFILE (A TC will be copied from paper type
to floppy disk).
TCCOPY F1.TEST,TCBUF1 (A floppy disk TC is copied into
computer memory).

```

TCCOPY is the only TC command which may reference floppy disk files. In order to use a TC on paper tape, magtape or floppy disk, it must first be copied into memory, that is, into TCBUF1, - TCBUF7.

Note that floppy disk files may be viewed, copied, or deleted using the floppy disk operating system. This is explained thoroughly in section 16.

### 3.3 Magnetic Tape Commands

REW	The REWIND command causes the magtape to rewind to the beginning of the first file.
WFMARK	The WFMARK command will write a file mark on the unit indicated by the parameter (M0-M3). If no parameter is present, unit 0 will be assumed.
SKIPF 0	The SKIPFILE 0 command positions the tape at the start of the current tape file.
SKIPF	<p>The SKIPFILE command indicates that a single file will be skipped on a magtape. Positive or negative skip values are acceptable for file skipping. A positive skip value will cause forward file skipping and a negative value will cause backward file skipping. File skipping in either direction will result in the tape being positioned at the start of a file. The SKIPFILE command will halt at the logical end of file. Some examples are as follows:</p> <p>SKIPF 2 This command causes the tape to skip two files and stop at the beginning of the third file.</p> <p>SKIPF -1 This command will cause a file just completed to skip backward and stop at the beginning of this same file.</p>

If you are windowing a file and still have lines remaining, a SKIPF command will bring you to the beginning of the next file or SKIPF 0 command will bring you to the beginning of the same file.

SKIPR	The SKIPRECORD command functions in the same manner as the SKIPFILE command only with respect to magtape records. The SKIPRECORD command will halt, however, at file marks regardless of the number of skip records indicated.
GETH	<p>The GETHEADER command will function properly with PMC headers only and if the density level on magtape is recorded properly. The header will be read from the file and displayed on the teletype console.</p> <p>Notice that a tape search and dump of all the files on a tape can be performed by using this command and a SKIPFILE command.</p> <p>Example as follows:</p> <p>-1&lt;GETH;SKIPF&gt; will perform a tape dump and stop at the end of tape.</p> <p>If a filename is included as a parameter, it will be compared with the name in the header. The header dump will be performed only if the names match. Example as follows:</p> <p>-1&lt;GETH,TESTFILE;SKIPF 1&gt; This command will search through the tape and dump the header of the file named TESTFILE.</p>
SETDEN	The SETDEN command accepts two parameters. The first can be either 800 or 1600 depending on the magtape density (bytes per inch) the user requires. Please note that the HDS indicator light on the tape deck being addressed will <u>not</u> be affected by the SETDEN command.

### 3.4 Plotter Commands

CI	The CARRIAGE INITIALIZE command will move the optical carriage to the left end stop and reset the origin to that position. The command recognizes no parameters.
----	--



MOVE	The MOVE command will step the carriage to an absolute position, in respect to the origin, indicated by the parameter. The position is expected to be given in millimeters. Note that a negative absolute position is possible if the user has reset the origin to the middle of the drum. Note also that a negative value indicates step left and a positive value step right.
OFFSET	The OFFSET command performs a function similar to that of the MOVE command. The carriage is moved either to the right or left relative to the current carriage position. A positive parameter indicates rightward stepping and a negative parameter indicates leftward stepping. This is always done in millimeters.
SETORG	The SET ORIGIN command accepts no parameters. The purpose of this command is to reset the software zero X-position. For example, the CI moves the carriage to the left end stop and resets the X-origin to that position. Now if the user were to enter the command MOVE 10 after the CI command, the carriage would be stepped 10mm to the right of the left end stop. If the same command were entered again, the carriage would not move as it would already be 10mm from the origin (left end stop). However, if the user were to enter a SETORG after the first 10mm move, the X-origin would be reset to the current carriage position, 10mm to the right of the left end stop. Consequently, a second entry of the MOVE 10 command would step the carriage 10mm to the right of the new origin to a position 20mm from the left end stop.
HGLIST	<p>The HGLIST command will display the contents of the histogram buffer. It accepts the following parameters:</p> <p><u>NONE</u> - The entire contents of the histogram buffer will be displayed along with the graph.</p> <p><u>NZ</u> - The frequencies of only those densities which are non-zero will be displayed.</p> <p><u>NG</u> - The density frequencies will be displayed without the graph.</p> <p><u>ONE NUMBER</u> - The frequency of that density will be displayed.</p> <p><u>TWO NUMBERS</u> - Specify an inclusive window of densities whose frequency will be reported.</p> <p><u>/N</u> - All frequencies below N will not be displayed. /N must be the last parameter.</p>

Note: If one wished to enter a window, the two numbers must appear consecutively separated by commas prior to a NG or NZ parameter (i.e.,25,100,NG).

HGEQU	The HISTOGRAM EQUALIZATION STRETCH command generates a transfer characteristic which results in a weighted contrast enhancement based on the number of pixels occurring in each of the density levels progressing from black to white. HGEQU requires the name of a valid TC buffer in order to function. The command assumes the user has generated a histogram of some image prior to its
-------	---

execution. The contents of the histogram buffer are used to calculate the equalization transfer characteristic which is deposited in the TC buffer indicated by the user.

**SETWEDGE** The SETWEDGE command will allow the operator to specify a step wedge. The command optionally accepts two parameters. The first parameter specifies the number of density levels the user wishes to see between 0 and 255. The second parameter is the word LINES. If the user uses this word, the wedge will be outlined. At load time, the wedge is set to 16 levels with no outline.

**HGWRITE** The HGWRITE command is used to write the current contents of the histogram buffer to an output device specified by the user. The current output devices which may be used are as follows:  
FLOPPY DISK FILES  
MAGTAPE

**HGREAD** The HGREAD command is used to read a histogram from an input device to the histogram buffer which resides in computer memory. The input devices which may be used are as follows:  
FLOPPY DISK FILES  
MAGTAPE

#### 4.0 SYSTEM VARIABLES

The setting of the system variables determines the manner in which the system responds to the user and how the transfers are carried out. For example, the variables will specify which devices are to be used in the transfer, whether the data is to be windowed, etc. Coordinates, however, indicate the size of the input window and the starting output position on the plotting surface.

In the following subsections each system variable and its possible settings will be discussed. Note that the possible settings will be indicated in parentheses.

**HEADER=** (NO, SKIP, USE) - The HEADER variable refers to PMC type headers on magnetic tape and its settings indicate the following:  
NO - The first record of the magtape file is not a PMC header.  
SKIP - The first record of the magtape is a PMC header but skip over it and do not use it.  
USE - The first record is a PMC record and use it for windowing or sizing the data.

**HIST=** (YES OR NO) - If the HIST system variable is set to YES, a histogram of the data being transferred will be compiled. If set to NO, the histogram will not be created.

**IN=** (MØ, TK, WEDGE, SCAN) - The IN system variable indicates which device will be used for input during the transfer. MØ represents the magtape unit. If TK is assigned to IN, the system will expect input from the keyboard during the transfer. WEDGE is the testing device built into the computer. SCAN refers to an Optronics scanner

(microdensitometer). Using the teletype keyboard for input is the means available for labeling films. For example, after typing:

LET IN=TK;RUN

The user will know the system is waiting for input by the exclamation point prompt (!). Termination of the transfer is accomplished by typing a CR after an empty line. If a window is in effect during input from the keyboard it will be applied in the y direction only.

Should the user assign IN to WEDGE, a step wedge will be generated and transferred according to the parameters indicated by the SETWEDGE command. If the input window is in effect (WINDOW=YES) then a wedge of the size described by XS, XE, YS, YE is transferred. If no window is in effect, a wedge 250mm x 250mm will be transferred.

INRAST= (25, 50, 100, 200 MICRONS) - The INRAST state variable indicates the raster of the input medium to the system. Note that input window coordinates will be calculated with respect to the INRAST setting. The number of bytes or records (lines) per millimeter is determined by this setting.

<u>MICRONS</u>	<u>BYTES/MILLIMETER</u>
25	40
50	20
100	10
200	5

OUTRAST= (25, 50, 100, 200 MICRONS) The OUTRAST variable is used to set the output raster of the plotter. The value used for the OUTRAST command must always be the same as the INRAST value.

KBSCALE= (A NUMBER 1-20) - The value assigned to KBSCALE is the magnification amount applied to pixels generated when the device assigned to IN is the TK. When the KBSCALE is set to one, each line input from the keyboard will generate eight output lines; each character will generate seven pixels. An appropriate scale to use is as follows:

<u>RASTER/MICRONS</u>	<u>KBSCALE</u>
25	8
50	4
100	2
200	1

OUT= (TY, PLOT, MØ, NULL) The OUT variable indicates which device will be written to during the data transfer. The devices indicated correspond to the teletype printer, photomation device, magnetic tape and NULL, a data sink.

POLARITY= (+ OR -) - The POLARITY variable is used to invert data. If it is set to positive (+), the data are not inverted and for color transfers zero (Ø) causes maximum film exposure (255 is minimum exposure). For black and white transfers zero causes minimum exposure (255 is maximum).

TC= (TCBUF1, TCBUF7, LINEAR, or NO) - If the TC variable is set to NO, no transformation will be applied to the data. If the variable is set to one of the TC buffers the TC indicated by that buffer will be applied to the data.

WINDOW= (YES OR NO) - If the window variable is set to NO, all the data read from the input device will be transferred to the output device. If the window is set to YES, only the data falling within the area specified by the input coordinates XS, XE, YS, YE will be transferred to the output device.

## 5.0 COORDINATES

Input window coordinates

XS = X Start  
 XE = X End  
 YS = Y Start  
 YE = Y End

Output position coordinates

XO = X Output position  
 YO = Y Output position

A coordinate can be assigned the value of any coordinate expression.

A coordinate expression consists of any amount with each separated by a plus (+) or minus (-) operator. Example as follows:

LET XS=XE+10  
 - Sets X start to X end plus 10 millimeters  
 LET XO=XO-P5  
 - Subtracts five pixels from the current X-output position

## 6.0 TELETYPE EDITING COMMANDS

This chart will indicate the functions performed by certain teletype keys.

<u>SYMBOL</u>	<u>KEY(S)</u>	<u>FUNCTION</u>
C	Control C	After being typed, the message will be printed and the current line will be cancelled
DEL	DELETE	Deletes the last character typed
R	CONTROL R	The current line is retyped
CR	Carriage Return	Executes a command line
ESC	Escape	When typed this will abort a list, a transfer or a command set
N	SHIFT N	Allow line continuation for extended command lines
D	CONTROL D	Used to display numeric listings in decimal
H	CONTROL H	Display listing in hexadecimal
A	CONTROL A	Displays listing in ascii
S	CONTROL S	Used when running a transfer to the

teletype. If typed, records will not be displayed until a control A, H, or D is typed.

To get a directory of all files on a tape:

? -1<GETH;SKIPF>

and it will dump the tape headers and stop at end of tape.  
If searching for a specific file:

? -1<GETH M1,TESTFILE;SKIPF1,M1>

will search through the tape on unit 1 and dump the header of the file titled TESTFILE.

## 7.0 WINDOWING

The function of an input window is to allow the user the capability of transferring only a section of the input data. If there is no window in effect, ODITS will serially transfer each record from the input device to the output device until a file-mark or end-of-tape mark is reached. If a window is in effect, the records and bytes not included in the window will not be transferred.

The input window is defined by the following coordinates:

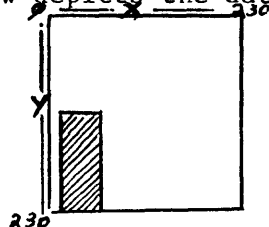
XS  
XE  
YS  
YE

These coordinates can be set to a value in millimeters or pixels.  
Suppose the input coordinates are set to the values below:

<u>25</u>	<u>50</u>	<u>100</u>	<u>200</u>
XS=2.5	XS=5	XS=10	XS= 20
XE=12.5	XE=25	XE=50	XE=100
YS=25	YS=50	YS=100	YS=200
YE=50	YE=100	YE=200	YE=400

If INTRAST and OUTRAST is set at 100, the first 10 millimeters of the input file in the X direction will be skipped. After reading to point 10 into the file, data will start to be transferred but only from 100 to 200 millimeters in the Y direction. Data will continue to be transferred until the 50 millimeter mark of the file is reached. Of course, if a file mark is found before that mark is reached, the transfer will terminate early.

The diagram below depicts the data which will be transferred.



A representation of a 230x230mm file with the darkened section indicating the window defined above.

Normally one wishes to plot a tape about which he only knows the number of lines and number of pixels per record. This example is for the INRAST and OUTRAST size of 100.

The following table will show the value of records or pixels per millimeter at different INRAST settings.

<u>INRAST (MICRONS)</u>	<u>PIXELS/MM</u>
25	40
50	20
100	10
200	5

If INRAST were set at 50 microns at the time the above window was defined, the records transferred would be 20 through 100 with bytes (pixels) 200 through 400.

If INRAST were set at 200 microns, the records transferred would be 5 through 25 with bytes (pixels) 50 through 100.

If INRAST were set at 25 microns the records transferred would be 40 through 200 with bytes (pixels) 400 through 800.

If a window ends before the file ends, the mag tape will remain at that spot. Before transferring a file, following a file that has just been windowed, a SKIPFILE command must be executed.

If the records (lines) on the file ends before the window ends, a SKIPF command is not needed before going to the next file. This is in the X-range.

When windowing an image that has a 21 line mask at the beginning of the file, it is necessary to use an XS parameter of 2.1 if the YS parameter is to be windowed beyond 100 pixels. When running the image at 25, 50 or 200 microns the XS parameter must be adjusted accordingly. That is:

25 microns is XS = .525  
50 microns is XS = 1.05  
100 microns is XS = 2.1  
200 microns is XS = 4.2

## 8.0 TRANSFER CHARACTERISTICS

Transfer characteristics are used in this system for the purpose of enhancing or manipulating images. If no TC is applied the density value of a pixel is the same on output as it is on input. Should a TC be in effect, the input density value of a pixel will be used as an index into a TC buffer. The contents of the TC buffer will then be transferred to the output device.

ODITS has eight TC buffers:

TCBUF1  
TCBUF2  
TCBUF3  
TCBUF4

TCBUF5  
TCBUF6  
TCBUF7  
LINEAR

The result of applying LINEAR during a transfer is equivalent to using no TC at all. The contents of the other buffers may be filled from a floppy disk or by using the TC editor.

### 8.1 Using The TC Editor

In order to operate the TC editor the user enters the command "TCEDIT" on the operator console. Following the "TCEDIT" command, the user must assign a buffer destination, followed by a carriage return (CR), such as:

TCEDIT TCBUF1.

After TC edit mode has been entered, the "?" prompt normally issued by the operating system will be replaced by a "\$" prompt which indicates TC edit mode.

### 8.2 TC Buffer Assignment

In order to edit a particular TC buffer the user must supply its name to the editor. This is accomplished by entering the name of a TC buffer as the first parameter following the "TCEDIT" command.

EXAMPLE:  
? TCEDIT  
\$ TCBUF1

### 8.3 Terminating TCEDIT

Terminating the TC edit procedure can be accomplished by entering a "TE" at the end of a sequence.

All of the numbers preceding the "TE" are deposited in the TC buffer named.

### 8.4 Editing Matching Pairs

To edit, on the terminal, TC's that have matching pairs, proceed as follows:

?TCEDIT TCBUF4 (CR)

As an example, if pairs to be edited are given to you as follows:

10 - Ø  
48 - 127  
125 - 255  
!0,10,0,0,10,48,0,127,48,125,127,255,125,255,255,255,TE

This will put the TC stretch into buffer 4 and the TE terminates the string.

Since the user commonly uses three different stretches (one for each color file), the next two will be put into buffers 5 and 6.

A film factor is always used, so that will be put into Buffer 7, thereby leaving Buffers 1, 2 and 3 empty to accommodate the combinations of the TC's and film factor.

## 9.0 USE OF FILM FACTORS

Film factors are used on images for enhancement. These have been generated by using a specific program (Duval, 1982a) that corresponds to the development procedures used by Pallas Photo Company that does our developing. Since the raster size varies, there is a set of Direct and Inverse Film Factors on a disk to be used with the correct raster size.

For Raster 100 the titles are:

FF1D100	FF1I100
FF2D100	FF2I100
FF3D100	FF3I100

For Raster 50 the titles are:

FF1D50	FF1I50
FF2D50	FF2I50
FF3D50	FF3I50

For Raster 25 the titles are:

FF1D25	FF1I25
FF2D25	FF2I25
FF3D25	FF3I25

For Raster 200 the titles are:

FF1D200	FF1I200
FF2D200	FF2I200
FF3D200	FF3I200

These film factors may be used alone or applied to TC's as directed by the user. For standard LANDSAT data an Inverse Film Factor is always used to create a positive image; if a negative is needed, a Direct Film Factor would be used. If applied to TC's generated by EDITING, an Inverse Film Factor is applied to the Direct TC's to generate a positive image.

Example:

?TCA TCBUF4,TCBUF7,TCBUF1

Transfer characteristics are in Buffer 4.

Film Factor 1I100 is in Buffer 7

The combined data of these two buffers are now in Buffer 1.



This process is used for all images as a rule. The film factors correspond to the raster size and are used accordingly.

## 10.0 COLOR INFRARED IMAGE (CIR) USING 3 FILES

To generate a color image at 100 microns with 2200 lines and 1900 pixels and using Film Factor 1 Inverse.

```
?LET INRAST=100,OUTRAST=100,KBSCALE=2,HEADER=SKIP,XO=0,YO=0
```

The INRAST and OUTRAST is set at 50 when the machine is brought up, so the parameters are changed to 100. The KBSCALE is at "1" so is changed to "2" to get a readable label. The HEADER=SKIP is required to avoid misregistration problems.

Film factors are applied to all images. These are stored on floppy disks under titles supplied by the operator.

To put these data into a buffer:

Insert floppy disk which contains the correct film factor into compartment number 1 of console.

```
?TCC F1.FF1I100,TCBUF1
```

Film Factor 1 Inverse, 100 micron data is now in Buffer 1.

The density is set at 800. If the magtape is at 1600 density, it is necessary to change the density.

```
?SETDEN 1600  
? 3<LETIN=TK;RUN;LET IN=M0,TC=TCBUF1;RUN>
```

The above sequence will signal for terminal input and at that time you should select a filter (red, green, blue) and do a CR. The sequence will repeat three times at 10 to 15 minute intervals, according to the size of the image. The image is now complete.

## 11.0 COLOR CODED IMAGE USING FILE NO. 1

Use the same parameters as when making a color image.

Insert the floppy disk which contains the color coded TC's in compartment number 1. The TC's are on the disk using the titles:

```
CCRG (for Red and Green)  
CCB (for Blue)  
to which the Film Factor 1 Direct needs to be applied.  
? TCC F1.CCRG,TCBUF4  
? TCC F1.CCB,TCBUF5
```

Insert disk with color film factors in compartment number 1.  
? TCC F1.FF1D100,TCBUF7

To apply the Film Factor to CC TC's,

```
? TCA TCBUF4,TCBUF7,TCBUF1
? TCA TCBUF5,TCBUF7,TCBUF2
```

and that places the combined TC's into Buffers 1 and 2.

\*\* To color code File No. 1:

```
?GETH (Get header)
? REW To avoid misregistration (SKIPF Ø if not file 1)
? LET IN=TK;RUN;LET IN=MØ,TC=TCBUF1;RUN;REW;LET
IN=TK;RUN;LET IN=MØ;RUN;REW;LET IN=MØ,TC=TCBUF2;RUN
```

The above sequence will signal for terminal input and at that time you should select a filter (red, green, blue) and do a CR. The sequence will repeat 3 times at 10 to 15 minute intervals; according to the size of the image.

The transfer is now complete.

A gray wedge and a color coded wedge are needed on this image. Please refer to "WEDGE" instructions in this manual.

## 12.0 COLOR CODED IMAGE USING FILES 2, 3, ETC.

```
? CI
```

After setting the origin using the SETORG command, it is always necessary to do a carriage return (CR) before proceeding to the next image.

Assuming that you are using the previous TC's already in Buffers 1 and 2.

```
? LET XO=2,YO=2 (resetting your parameters)
? GETH (to verify that you are using the correct file)
? SKIPF Ø (to avoid misregistration)
? LET IN=TK;RUN;LET IN=MØ,TC=TCBUF1;RUN;SKIPF-1;LET
IN=TK;RUN;LET IN=MØ,TC=TCBUF1;RUN;SKIPF-1;LET IN=TK;RUN;LET
IN=MØ,TC=TCBUF2;RUN
```

The above sequence will signal for terminal input and at that time you should select a filter (red, green, blue) and do a CR. The sequence will repeat three times at 10 to 15 minute intervals, according to the size of the image.

The transfer is now complete.

A gray wedge and a color coded wedge are needed on this image. Please refer to "WEDGE" instructions in this manual.

## 13.0 LABELS

If the label is to immediately follow the image, proceed as follows:

```
? SETORG (sets the origin at the X-range location)
? LET TC=NO,IN=TK;RUN
```

Label input is signaled by an exclamation point (!)  
\*\*Press white filter button on Photomation:

! Enter label  
! CR (to terminate input)

The label is now complete.

If the label is to be placed in a different location, the user will designate the XO parameter.

When doing labels at various microns, the most suitable scales are as follows:

100 MICRONS - KBScale = 2  
50 MICRONS - KBScale = 4  
25 MICRONS - KBScale = 8  
200 MICRONS - KBScale = 1

#### 14.0 GRAY WEDGE

The wedge immediately follows the label so proceed as follows:

? SETORG  
? SETWEDGE 26,LINES  
? LET WINDOW=YES,XE=4,YE=180

These Parameters will generate a wedge 4mm wide and 180mm long with lines separating the 26 steps of the wedge.

? 3<LET IN=TK;RUN;LET IN=WEDGE;RUN>

The above sequence will signal for terminal input and at that time you should select a filter (red, green, blue) and press CR only. The sequence will repeat three times.

The wedge is now complete.

If you are also putting a color-coded wedge on the image, your parameters for the gray wedge will be as follows:

?LET WINDOW=YES,XE=4,YE=32

If the user wishes to have the wedge placed in a different location, he/she will designate the XO parameter.

#### 15.0 COLOR CODED WEDGE

When generating a color-coded wedge, it is assumed that a gray wedge has already been placed on the film immediately following the label using the parameters XE=4 AND YE=32.

? SETWEDGE 256  
? LET YO=50,YE=140

You are now using the TC's that are in Buffers 1, 2 and 3.

```
?LET IN=TK;RUN;LET IN=WEDGE,TC=TCBUF1;RUN;LET IN=TK;RUN;LET
IN=WEDGE,TC=TCBUF2;RUN;LET IN=TK;RUN;LET IN=WEDGE,
TC=TCBUF3;RUN
```

The above sequence will signal for terminal input and at that time you should select a filter (red, green, blue) and press CR only. The sequence will repeat three times.

The wedge is now complete.

## 16.0 WINDOWED IMAGE (EXAMPLE)

To do an image that is to be windowed, the following sample parameters must be known:

```
XS = 10
XE = 230
YS = 1
YE = 190
XO = Ø
YO = Ø
```

The example is done at 100mm and uses three consecutive files with 2400 lines and 2000 pixels. Presuming you are using a film factor that is in Buffer 1, proceed as follows:

```
? LET INRAST=100,OUTRAST=100,KBSCALE=2,HEADER=SKIP;XO=Ø,
YO=Ø,XS=10,XE=230,YS=1,YE=190
? 3<LET IN=TK;RUN;LET IN=MØ,TC=TCBUF1;RUN;SKIPF>
```

The above sequence will signal for terminal input and at that time you should select a filter (red, green, blue) and do a CR. The sequence will repeat three times at 10 to 15 minute intervals.

The transfer is now complete.

## 17.0 WINDOWING AN IMAGE USING TC'S

To window an image and to use different TC's for each file, the procedure is as follows:

Assuming the appropriate TC's have been placed in Buffers 1, 2 and 3, for files 1, 2 and 3.

```
? LET IN=TK;RUN;LET IN=MØ,TC=TCBUF1,RUN;SKIPF;LET
IN=TK;RUN;LET IN=MØ,TC=TCBUF2,RUN;SKIPF;LET IN=TK;RUN;LET
IN=MØ,TC=TCBUF3;RUN
```

The above sequence will signal for terminal input and at that time you should select a filter (red, green, blue) and do a CR. The sequence will repeat three times.

The transfer is now complete.

## 18.0 TRANSFERRING DATA FROM BUFFER TO DISK

To transfer characteristics onto disks, insert a blank floppy disk into Unit 0, push "write protect" off.

Assuming the data in Buffers 4, 5 and 6 are to be put on a disk,

```
? TCC TCBUF4,F0.RED
? TCC TCBUF5,F0.GRN
? TCC TCBUF6,F0.BLU
```

and these data will be stored on the disk until deleted.

## 19.0 BLACK/WHITE LANDSAT IMAGE

To generate a positive black/white image from LANDSAT data, an INVERSE Film Factor must be used. If a negative is needed (necessary when making a print) a DIRECT Film Factor must be used. If a TABLE, AUTOTC, EQUALIZATION, or SPLICE TC is used, it must be put on disk or in the buffer as positive (+) and be combined with the correct film factor.

```
? TCEDIT TCBUF4
$ 0 - 255, TE
```

or

```
? TCC F1.TITLE,TCBUF4
```

Insert the disk containing Film Factors into compartment number 1 of the console.

```
? TCC F1.FF11100,TCBUF7
? TCA TCBUF4,TCBUF7,TCBUF1
```

Your TC's are now in Buffer 1 so proceed as follows:

```
? LET INRAST=100,OUTRAST=100,KBSCALE=2,XO=2,YO=2,
TC=TCBUF1;RUN (CR)
```

## 20.0 COMPILING A HISTOGRAM

If you wish to compile a histogram of data being transferred

```
? LET HIST=YES (CR)
```

before running the program.

After transfer is complete, to get a print-out of the histogram

```
? HGL (CR)
```

Note that the transfer rate will be slowed down.

## 21.0 GENERATING TC'S USING THE REMAPP4 PROGRAM

## 21.1 TC's To Disk

Insert DOS10 program disk in Unit 0 and REMAPP4 program disk in Unit 1 of console.

Bring the system up by using the same procedure as for the ODITS program:

```
* (Teletype print-out)
? (Operator's response)
* MM/DD/YY
? /AS SF=F1
? /AS 04=PP
? /T1=TIME
? /DA=DATE
? /EX TABLE
```

Insert your blank disk into console and turn off WRITE PROTECT" light:

```
* PROGRAM TABLE
* TC TO DISK/PAPER TAPE D/T
? D
* ASSIGN UNIT 7 TO TC FILE, etc
? /AS 07=F1.TITLE
? /RE
* NUMBER OF MAPPING PAIRS
? N
* INPUT MAPPING PAIRS
? N,N
* DIRECT (+) OR INVERSE (-)
? + or -
* EYESTRETCH FACTOR ?
? 0
* COLOR FILM FACTOR? 0=NONE
? 0
* ANOTHER RUN?
? N
```

If you wish to execute the program again

```
? /BE or
? /EX TABLE
```

These data will now be recorded on the disk under the title you assigned it and will remain there until they are deleted.

If you wish to apply a film factor to these data, this is done when you run the ODITS program to generate an image.

## 21.2 TC's To Paper Tape

Use the above procedure to bring up the /EX TABLE program, and proceed as follows:

Turn the Paper Tape Punch console to "ON"

```

* (Teletype print-out)
? (Operator's response)
? /EX TABLE
* PROGRAM TABLE
* TC TO DISK/PAPER TAPE D/T
? T
* READY PUNCH, TYPE <RETURN>
? (CR)
* NUMBER OF MAPPING PAIRS?
? N
* INPUT MAPPING PAIRS
? N, N
* DIRECT (+) OR INVERSE (-)
? +
* EYESTRETCH FACTOR
? Ø
* COLOR FILM FACTOR Ø=NONE
? Ø
* ANOTHER RUN?
? Y

```

You may use the Y (YES) here if you wish to generate more tapes.

### 21.3 TC's To Paper Tape Including Film Factors

Use the above procedure to bring up the /EX TABLE program, and proceed as follows:

Thread the correct film factor paper tape you are applying to the new stretch into the Paper Tape Punch Reader on console. When the computer asks for:

```
COLOR FILM FACTOR? Ø=NONE;1/2/3=OLD;4/5/6=NEW
```

answer with a 4, 5, or 6 and the new tape punched will have the film factor applied. This film factor is not stored in a buffer, so must be re-threaded into the Reader each time a new tape is punched.

### 21.4 Slice TC's To Paper Tape/Disk

If the SLICE data is to be stored on disk, insert the disk in the proper compartment, or if on paper tape, turn on the Paper Tape Punch console and use the same procedure as above that brings up the TABLE program:

```

* (Teletype print-out)
? (Operator's response)
? /EX SLICE
* PROGRAM SLICE
* TC TO DISK/PAPER TAPE D/T
? D
* ASSIGN UNITS 7/8/9 to R/G/B TC FILES
? /AS 7=FØ.RED
? /AS 8=FØ.GRN
? /AS 9=FØ.BLU
? /RE
* ENTER NO., COLOR VALUE:

```

```

? N, N
* NUMBER OF MAPPING PAIRS?
? N
* INPUT MAPPING PAIRS
? N, N
* DIRECT (+) OR INVERSE (-)
? +
* ANOTHER RUN
? N if on disk
? Y if on paper tape

```

## 21.5 AUTOTC's To Paper Tape/Disk

Use the same procedure as above to bring up the AUTOTC program, and the same instructions for placement on disk or paper tape.

Mount magtape on PERTEC tape drive:

```

? /EX AUTOTC
* TAPE DATA INPUT=Ø; STOP=99?
? Ø
* TC TO DISK/PAPER TAPE D/T
? D
* ASSIGN UNITS 7/8 TO TC+/-FILES
? /AS 8=FØ.AUTOTC
? /RE

```

or

```

? T (Turn "ON" Paper Tape Punch)
* NO. OF FILES TO SKIP
? Ø
* ENTER SCANLINE 1ST, NO., SKIPS:
? 21,2100,10
* PIXEL S/LINE=N
* ENTER PIXEL 1ST, NO., SKIPS
? 150,1500,10
* ENTER RANGE OF DN TO INCLUDE
? Ø,255
* DIRECT/INVERSE/BOTH TRANSFER (+/-/B):
? B
* EYESTRETCH FACTOR Ø=NONE
? Ø
* COLOR FILM FACTOR Ø=NONE; 1/2/3=OLD;4/5/6=NEW
? Ø if disk, 4 if paper tape
* TAPE DATA INPUT = Ø;STOP=99?
? 99

```

Note that only 800 BPI tapes may be used for this program. If data is on 1600 BPI tapes, use the HGEQU program

## 21.6 Directory Of Disk

Insert the DOS10 program disk into compartment 1 of CPU console and the disk to be read into compartment Ø.



Use the same procedure to bring the program up as for TABLE and proceed as follows:

```
? /EX OS:VEW,FØ,N,TE
```

and all data titles will be printed out on the teletype

### 21.7 Delete Files

```
? /EX OS:CPY
? DE,FØ.file name
? DE, FØ.etc.
```

After all files you wish to delete are deleted, to pack the remaining files, type:

```
? PK,FØ,TE
```

If there is an error, to get back into the program, type:

```
/CA (CR)
/BE (CR)
```

### 21.8 Directory Of TC's Using OTIS Program

Insert ODITS program disk into compartment FØ of CPU console and the disk to be read into compartment F1, and turn off the "WRITE PROTECT" light. Bring up the program using the usual procedure, and type:

```
/EX OS:VEW,F1,N,TE
```

and all data titles will be printed out on the teletype.

### 21.9 Delete TC's Using OTIS Program

Use the same procedure as above, except type:

```
/EX OS:CPY
? DE,F1.file name
? DE,F1.file name
? PK,F1,TE
```

This packs the remaining files after all deletions.

If you make an error, to get back into the program, type:

```
/CA (CR)
/BE (CR)
```

### 22.0 HISTOGRAM EQUALIZATION TC

Use the ODITS program for this transfer:

```
* (Teletype print-out)
? (Operator's response)
? LET HIST=YES,OUT=NULL,WINDOW=YES,IN=MØ,XO=Ø,YO=Ø,XS=Ø,
XE=230,YS=Ø,YE=230;RUN
```

Wait for tape to stop at end of file.

```
? HGEQU TCBUF4
* ENTER INPUT MIN AND MAX DENSITY VALUES
? Ø,255
? RUN (CR)
? REW
```

If using less lines than file encompasses, you must use a SKIPF command to get to the next file.

When windowing to avoid the MASK, use the following parameters:

```
? XS=2.1,XE=210,YS=15,YE=165
```

If a film factor is to be used, do a TCA, using the buffer containing the HGEQU TC's and the buffer containing the correct film factor for each file.

When all files are complete, change the parameters for running an image as follows:

```
? LET HIST=NO,OUT=PLOT,WINDOW=NO,XO=2,YO=2,IN=MØ,
TC=TCBUF(N);RUN
```

### 23.0 BLACK/WHITE FILM QUALITY CONTROL TEST

Use the ODITS program and Quality Control (Duval, 1982b) magtape number TAGØØ9.

Load a piece of B/W film that has a Sensitometer Wedge generated on it. The meter is set at .78 for this wedge.

Set the Inrast and Outrast at 100 microns, and proceed as follows:

```
? LET XO=30,YO=10,POLARITY=-, (minus) KBSCALE=2 (CR)
? 3<LET IN=MØ;RUN;LET XO=XO+5;REW>;LET XO=XO+5,POLARITY=+,
IN=TK;RUN (CR)
!NO FILM FACTORS
```

Insert disk containing color film factor TC's into compartment 1 of CPU console:

```
? TCC F1.FF1IBW,TCBUF1
? TCC F1.FF2IBW,TCBUF2
? TCC F1.FF3IBW,TCBUF3
? LET XO=XO+5,IN=MØ,TC=TCBUF1;RUN;REW;LET
XO=XO+5,TC=NO,IN=TK;RUN
! FILM FACTOR 1
```

and continue doing the same for film factors 2 and 3.

To put a label on the bottom, type:

```
? LET XO=XO+5,IN=TK;RUN
! DATE - HIGH SPEED B/W OPTRONICS TEST
! DS=8, SIZE=100B - 8FPM PROCESSING
```

## 24.0 COLOR FILM QUALITY CONTROL TEST

Use the ODITS program and Quality Control (Duval, 1982b) magtape number TAG009.

Load a piece of color film that has a Sensitometer Wedge generated on it. The sensitometer is set at .78 for this wedge.

Set the Inrast and Outrast at 100 microns, and proceed as follows:

### 100 MICRONS

```
? LET XO=30,YO=10,KBSCALE=2 (CR)
? 3<LET IN=TK;RUN;(here you press the red, green, blue
filters in consecutive order, when the beep sounds) LET
IN=MØ,RUN;REW;LET XO=XO+5>;3<LET IN=TK;RUN; (press red,
green, blue filters) LET IN=MØ;RUN;REW>;LET XO=XO+5,IN=TK;
(press white filter) RUN (CR)
! NO FILM FACTORS (100 MICRONS)
```

Insert disk containing color film factor TC's into compartment 1 of CPU console:

```
? TCC F1.FF1D100,TCBUF1
? TCC F1.FF2D100,TCBUF2
? TCC F1.FF3D100,TCBUF3
? LET XO=XO+5
? 3<LET IN=TK;RUN; (press red, green, blue filters) LET
IN=MØ,TC=TCBUF1;RUN;REW>;LET XO=XO+5,TC=NO,IN=TK;RUN (press
white filter) (CR)
! FILM FACTOR 1 (100 MICRONS)
```

Do the same procedure for Film Factors 2 and 3.

```
? LET XO=XO+5;RUN
! SIZE=100 MICRONS, DS=4
```

### 25 MICRONS

The second file is to be run at 25 microns, so proceed as follows:

Change the settings on Photomation and the raster to 25 and the drum speed to 2:

```
? LET INRAST=25,OUTRAST=25,KBSCALE=8 (CR)
? LET XO=XO+5
? SKIPF;GETH (CR)
? SKIPF Ø (CR)
? 3<LET IN=TK;RUN (press red, green, blue filters) LET
IN=MØ;RUN;SKIPF-1>;LET XO=XO+5,IN=TK;RUN (press white
filter)
!SIZE = 25 MICRONS, DS=2
```

The third file is to be run at 50 microns, so proceed as follows:

Change the settings on the Photomation and the raster to 50 and the drum speed to 4:

```
? LET INRAST=50,OUTRAST=50,KBSCALE=4 (CR)
? LET XO=XO+5 (CR)
? SKIPF;GETH (CR)
? SKIPF Ø (CR)
? 3<LET IN=TK;RUN (press red, green, blue filters) LET IN=
MØ;RUN;SKIPF-1>;LET XO=XO+5,IN=TK;RUN (press white
filter)
! SIZE = 50 MICRONS, DS=4
```

#### 200 MICRONS

The fourth file is to be run at 200 microns so proceed as follows:

Change the settings on the Photomation and the raster to 200 and the drum speed to 4:

```
? LET INRAST=200,OUTRAST=200,KBSCALE=1 (CR)
? LET XO=XO+5 (CR)
? SKIPF;GETH (CR)
? SKIPF Ø (CR)
? 3<LET IN=TK;RUN (press red, green, blue filters) LET IN=
MØ;RUN;SKIPF-1>;LET XO=XO+5,IN=TK;RUN (press white filter)
!SIZE=200 MICRONS, DS=4
? LET XO=XO+5;RUN
! DATE - COLOR OPTRONICS TEST
! SIZES = 25,50,100,200 - PUSH ONE STOP
```

### **25.0 CREATING BLACK/WHITE FILM FACTORS ON HIGH SPEED OPTRONICS (SYSTEM C-4300)**

Load a piece of black/white film.

Set the rasters at 100 microns.

a) Load Quality Control (Duval, 1982b) Magtape TAGØØ9 using the first file, proceed as follows:

```
?LET POLARITY=-,XO=10,YO=10,IN=MØ;RUN;REW;LET
XO=50;RUN;REW;LET XO=100;RUN;LET XO=XO+5,IN=TK;RUN
! HIGH SPEED B/W FILM FACTOR WEDGES - DATE
```

Make approximately 3 copies (one on each of 3 consecutive days) using the above procedure and after these are developed, proceed to the next step.

b) Using the TD-504 Densitometer, digitize each of the 26 steps in the wedges and record the results for the next step.

c) Using the readings from the Densitometer, calculate the average density of each of the 26 steps and use these averages to run the PWRFIT program (Duval, 1982) on the Optronics for the new film factors.

d) Using the High Speed Optronics computer, insert the DOS10 disk in compartment No. 0 and the REMAPP4 disk in compartment number 1.

Bring up this program by pressing the same controls as for the ODITS program. You are now ready to execute the PWRFIT program by typing:

```
* (Teletype print-out)
? (Operator's response)
?>/EX PWRFIT
* HOW MANY DATA POINTS TO BE ENTERED?
? 27
* HOW MANY TERMS IN THE POWER SERIES?
? 6
* ENTER A ONE LINE LABEL
? HIGH SPEED B/W FILM FACTORS - DATE
* ENTER VALUES OF X, Y, AND WT FOR DATA POINT #1
? 0, 0.15, 1 (CR)
? 10, 0.19, 1 (CR)
? 20, 0.21, 1 (CR)
until 27 data points are entered.
```

Note: Each step on the form used with the average density level is recorded in increments of 10, i.e.: 0, 10, 20, 30, 40, etc., and 0 is the first number entered followed by a comma. The next number entered is the average density reading of the first wedge step and is put in as 0.15 and followed by a comma. The third entry is always a one (1), and a (CR). This process is continued for 26 steps, changing the X and Y values each time accordingly.

```
* WOULD YOU LIKE TO MAKE ANY CHANGES?
? N (NO)
```

If an error has been made just answer "Y" and follow the instructions printed out on the terminal, for correcting the error. Remember to put in all three values (X, Y, WT) when changing any digit, such as:

0,0.15,1 changed to read 0,0.17,1

```
* DO YOU WANT TO RUN THE PROGRAM AGAIN?
? N
* PROGRAM FINISHED
```

You are now ready for the TCCALC program (Duval, 1982c), so proceed as follows:

Bring up the REMAPP4 program on the CPU

```
?/EX TCCALC
* ENTER A ONE-LINE TITLE
? High speed B/W Film Factor - Date
* ENTER FD1, DN1, FD2, AND DN2
?.N,0,N.N,255 (CR)
```

Note: The FD1 (Film Density No. 1) number is taken from COEFFICIENT No. 1 of the Power series which is generated by the PWRFIT program and is brought down to the 1/100th power. Example: Coefficient No. 1 = 1.67886E-01 so the FD1 = .167. The DN1 number is the minimum DN and is always a zero (0). The FD2 (Film Density No. 2) number is always 2.0 for Film Factor 1, 1.7 for Film Factor 2, and 1.4 for Film Factor 3 (Duval, 1982c). The DN2 number is the maximum DN and is always 255. In this case the response for the above question would be ? .167,0,2.0,255.

\* ENTER THE 6 COEFFICIENTS OF THE POWER SERIES  
? N,N,N,N,N,N (CR)

Note: These 6 coefficients are found in the PWRFIT program under the title: HERE ARE THE COEFFICIENTS OF THE POWER SERIES. These are reduced to 4 places and entered on one line separated by commas. An example as follows:

Coefficient #1 = 1.50667E-01 and entered as 1.507E-1  
Coefficient #2 = -8.57276E-03 and entered as -8.573E-3  
Coefficient #3 = 5.49833E-04 and entered as 5.498E-4  
Coefficient #4 = 5.57934E-06 and entered as -5.579E-6  
Coefficient #5 = 2.25865E-08 and entered as 2.259E-8  
Coefficient #6 = -3.21828E-11 and entered as -3.218E-11

The response for the above question would be:

? 1.507E-1,-8.573E-3,5.498E-4,-5.579E-6,2.259E-8,  
-3.218E-11 (CR)

The terminal will then print out the new film density levels as Film Factor 1, and these are to be stored on a disk.

\* TC TO DISK/PAPER TAPE? (D/T)  
? D

At this time insert a disk into compartment number 0 in the CPU console. Let the REMAPP4 remain in compartment number 1 of the CPU console.

\* ASSIGN UNIT 7 TO DIRECT FILE  
\* ASSIGN UNIT 8 TO INVERSE FILE  
? >/AS 07=F0.6 letter name (Direct)  
? >/AS 08=F0.6 letter name (Inverse)  
? >/RE

Use this same TCCALC program to create film factors 2 and 3, using the same coefficient numbers and changing the FD2 (2.0 for Film Factor 1, 1.7 for Film Factor 2, 1.4 for Film Factor 3) reading only and the Direct and Inverse titles on disk.

## 26.0 CREATING BLACK/WHITE FILM FACTORS FOR USE ON THE PHOTOMATION (SYSTEM P-1700)

Follow the same procedure as when creating film factors for use on the High Speed Optronics.

Generate test wedges on B/W film and calculate density averages, using the following commands on B/W Optronics Photomation (System P-1700).

```
? PM:<MT:
* X START = 30
* X END = 34
* Y START = 10
* Y END = 190
* + OR - (-)
```

Rewind

```
? PM:<MT:
* X START = 100
* X END = 104
* Y START = 10
* Y START = 190
* + or - (-)
```

a) Run the PWRFIT program following the same procedure as on the High Speed Optronics, except changing the ONE LINE LABEL to OLD B/W FILM FACTORS - DATE

b) Run the TCCALC program following the same procedure as on the High Speed Optronics, using the Coefficient density level numbers created by the PWRFIT program

At this time, turn on the CPU console holding the paper tape.

When the terminal asks:

```
* TC TO DISK/PAPER TAPE ? (DT)
? T
* READY PUNCH, TYPE <RETURN>
? (CR)
```

and a paper tape will be punched containing Film Factor One Direct and Film Factor 1 Inverse

Use this same TCCALC program to create Film Factors 2 and 3, using the same coefficient numbers.

## 27.0 CREATING COLOR FILM FACTORS

Bring up the computer using the ODITS program. Load a piece of color film that has a sensitometer wedge.

```
Load Quality Control Magtape TAG009.
Set the rasters at 100 microns.
Using the first file, proceed as follows:
?LET INRAST=100,OUTRAST=100,KBSCALE=2,X0=20,Y0=10
?3<LET IN=TK;RUN;LET IN=M0;RUN;REW>;(at the beep, press the
red, green, blue filters in that order) LET
X0=X0+5,IN=TK;RUN (Press white filter)
! COLOR WEDGE FOR NEW FILM FACTORS - 100 MICRONS
```

Remove cassette and set rasters at 25 microns and drum speed at 2. Re-insert cassette.

```
?LET INRAST=25,OUTRAST=25,KBSCALE=8,X0=40
```

Go to the second file "WEDGE 25 MM" and continue

```
? 3<LET IN=TK;RUN;LET IN=MØ;RUN;SKIPF-1>;  
(Press red, green and blue filters at the beep) LET  
X0=X0+5,IN=TK;RUN (Press white filter) (CR)  
! COLOR WEDGE FOR NEW FILM FACTORS - 25 MICRONS
```

Remove cassette and set rasters at 50 microns and drum speed at 4. Re-insert cassette.

```
?LET INRAST=50,OUTRAST=50,KBSCALE=4,X0=60
```

Go to the third file "WEDGE 50 MM" and continue

```
? 3<LET IN=TK;RUN;LET IN=MØ;RUN;SKIPF-1>;  
(Press red, green and blue filters at the beep)  
LET X0=X0+5,IN=TK;RUN (Press white filter) (CR)  
! COLOR WEDGE FOR NEW FILM FACTORS - 50 MICRONS
```

Remove cassette and set rasters at 200 microns. Re-insert cassette

```
?LET INRAST=200,OUTRAST=200,KBSCALE=1,X0=80
```

Go to the fourth file "WEDGE 200 MM" and continue

```
? 3<LET IN=TK;RUN;LET IN=MØ;RUN;SKIPF-1>;  
(Press red, green and blue filters at the beep) LET X0=  
X0+5,IN=TK;RUN (Press white filter) (CR)  
! COLOR WEDGE FOR NEW FILM FACTORS - 200 MICRONS
```

Follow the same procedure as in 25.0 "CREATING B/W FILM FACTORS ON HIGH SPEED OPTRONICS (SYSTEM C-4300)", generating the PWRFIT and TCCALC programs. These programs are run separately for each of the 100, 25, 50 and 200 micron step wedges. The titles will have to be changed to correspond to the appropriate microns.

## 28.0 REFERENCES

- Optronics International, 1981, Optronics digital image transfer system, ODITS user manual.
- Duval, J. S., 1982a, Image production equipment and procedures: U. S. Geological Survey Open-File Report 82-534, 21 p.
- Duval, J. S., 1982b, A method for designing film transfer functions for use in an image processing laboratory: U.S. Geological Survey Open-File Report 82-705, 21 p.
- Duval, J. S., 1983c, Procedures for accurate color reproduction of color images made from digital data in Journal of Technology v. 10, no. 1, p. 16-22.