FOS Dead Diode Reference Files: A Quick Reference Guide to the Appropriate File for a Particular Date and Instrumental Configuration

Cynthia J. Taylor
Space Telescope Science Institute

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Abstract

Complete tabulations of *recommended* Dead Diode reference files (.r4h, .r4d) for each specified USEAFTER date are presented in a convenient matrix format ***AS OF 6 AUGUST 1994***. List of all Dead Diode reference files delivered to Calibration Data Base System (CDBS) will be in CAL/FOS-113.

ASCII text and Postscript versions of the tables and explanatory test in this report will be maintained on STEIS and will be available for anonymous ftp from *stsci.edu*. Both the STEIS tables and explanatory text will be updated periodically.

I. Introduction

Each pixel in an FOS spectrum contains contributions from several neighboring diodes. A diode will contribute to a fixed number (NXSTEPS × OVERSCAN) of pixels (usually 20). Therefore when a diode dies or becomes noisy, there is an "absorption line" (for dead diodes) or an "emission line" (for noisy diodes) that is NXSTEPS × OVERSCAN pixels wide.

Once a diode is identified as dead or too noisy (see Section III), it must be disabled onboard the spacecraft. The disabling is done via the commanding instruction, *lydif_chnl*, and is made at the start of a Science Mission Schedule (SMS).

CALFOS corrects for the disabled diodes as part of the conversion to count rates step (see HST Data Handbook, "Conversion to Count Rates", page 269 for more detail). The list of disabled diodes is taken either from the appropriate dead diode reference file or from the unique data log (.ulh) depending on the value of the science header keyword, DEFDDTTBL. If the value of DEFDDTTBL value is **TRUE** then the list of disabled diodes is taken from the unique data log. If DEFDDTTBL is **FALSE**, then the disabled diode list is from the dead diode reference file. Since April 1992 the default value for DEFDDTTBL has been **FALSE**.

If a given pixel has one (or more) disabled or dead diodes contributing to its value then CALFOS corrects the pixel value by the following equation:

$$corr = obs \frac{total}{(total - dead)}$$

where *corr* is the corrected pixel value, *obs* is the observed pixel value, *total* is the total number (live + dead) diodes contributing to the pixel, and *dead* is the number of dead diodes contributing to the pixel (HST Data Handbook, page 269). OVERSCAN number of diodes contribute to a given pixel value.

II. Description of the Tables

It is very important to use the correct reference file for the appropriate date and detector. Tables 1 and 2 show the recommended Dead Diode reference files for each detector and observation date. The first column is the Dead Diode reference HEADER file (the corresponding Dead Diode reference DATA file, .r4d, is not listed in the table). The "Begin Date" is the USEAFTER date associated with each file and is the earliest date a file should be used. The "End Date" is the last date a file should be used. The last column shows the diodes disabled on the scale of 0-511 (IRAF/STSDAS is on the 1-512 scale - see below for explanation).

Note that in Table 2, files *das1303py.r4h* and *d9h1244ay.r4h* have the exact same diodes disabled. This is because they are copies of the same file. A mistake in the USEAFTER date was made during delivery. Either file will be correct to use for Blueside data taken after September 7, 1993. A complete history of all the delivered Dead Diodes reference files will be covered in CAL/FOS-113.

An inappropriate file will result in calibration errors as seen in Figure 1 (see also HST Data Handbook, "Effect of Incorrect Dead Diode Reference File", page 234). Figure 1a shows the raw data file (.d0h) with the disabled diodes (labeled 1-20). Figure 1b shows the calibrated count rate file (.c4h) with an incorrect Dead Diode reference file applied. Diodes "2", "3", and "5" are disabled diodes that are not listed in the reference file, while diode "6a" is an enabled diode that was listed as disabled. Figure 1c shows the calibrated count rate file with the correct Dead Diode reference file applied.

Tables 3.1 and 3.2 show the list of: disabled dead, disabled cross-wired (in Table 3.1), disabled noisy, enabled but possibly noisy, and enabled but intermittently dead (in Table 3.2). The diodes listed are on the 0-511 scale. Tables 4.1 and 4.2 show the dates of when the dead and noisy diodes were noticed and disabled. Note that some of the noisy diodes have been disabled and then enabled.

III. Identification of Diodes

New dead or noisy diodes can easily be identified by comparing the raw data file (.d0h) to the calibrated file (.c1h or .c4h). The raw data file will have several sharp edged absorption features

(that are exactly NXSTEPS × OVERSCAN pixels wide) that are due to disabled diodes (see Figure 1a). If there is an absorption feature in the same pixel range in the calibrated file as in the raw data file and you have verified you are using the appropriate Dead Diode file for the observation date, then the feature is a new dead diode. If there is a sharp edged emission feature in both the raw and the calibrated data (see Figure 2 around pixel 400) then it's a noisy diode. If the emission line is just in the calibrated data, then you used an incorrect Dead Diode reference file.

To identify the diode that is noisy/dead, you must determine the range of pixels that are affected. The easiest method is to plot the region around the affected pixels. {If you are using the IRAF/ STSDAS task **sgraph**, please use caution in your pixel range since IRAF assigns "1" to the first pixel of the range (i.e. if you plot pixels 155 - 206, pixel 155 will be assigned "1"). It is a good idea to start the pixel range on a "1".} Determine the first pixel that is affected. The diode affected (on 0-511 scale) is:

$$\text{(for IRAF) } DIODE = \frac{pixel - 1}{NXSTEPS} \qquad \text{(for IDL) } DIODE = \frac{pixel}{NXSTEPS}$$

where *pixel* is the first pixel affected. You have to subtract one from the pixel number in IRAF because IRAF pixel range is from 1 to 2064 (for NXSTEPS = 4 and OVERSCAN = 5) while IDL pixel range is from 0 to 2063. The diode range convention is based on IDL, hence the range 0-511. However IRAF uses the 1-512 numbering convention. Thus if you **listpix** the Dead Diode reference file or have data with NXSTEPS = 1 and OVERSCAN = 1, you will have to subtract one from the pixel number (which is the same as the diode number) to get the "proper" diode number.

If you have discovered a new dead or noisy diode, please contact Research Support Branch Analysis Hot Line (telephone: (410) 338-1082 or e-mail: *analysis@stsci.edu*). For dead diodes, usually a new Dead Diode reference file will be made available so you can recalibrate your data. Announcements of new Dead Diode reference files will be posted on STEIS. If you don't want to recalibrate your data, you can use the IRAF task **fixpix** and the equation on page 2 to manually correct the affected pixels. If you have a noisy diode, unfortunately you can't remove the noisy diode effect by recalibrating the data. You can use IRAF tasks **fixpix** or **splot** (in the *etch-a sketch* mode) to smooth over or blank out the affected pixels (HST Data Handbook, "Effect of Noisy Diode", page 236). In the future, there will be an STSDAS task that will correct for dead and noisy diodes or for an incorrect Dead Diode reference file without having to recalibrate the data. The test version is currently only available at STScI in the **stlocal.testfos** package as the task **fixdiodes**.

IV. Creation of Reference Files

Compared to other reference files, the Dead Diode reference file is very simple. It is a one dimensional image consisting of ones and zeros. Disabled diodes are given the value of zero. New files are created by editing the previous version and changing the value of the diode from "1" to "0". If the reference file is edited using the IRAF task **epix**, the pixel that is edited is the diode number plus one (remember that IRAF is on the 1-512 scale, while the diode numbering convention is 0-511).

For dead diodes, a new Dead Diode reference file is created as soon as possible. The FOS calibration team tries to establish the time when the diode "died". It is possible that the diode will be intermittently dead before completely dying. Once a "time of death" has been established it becomes the USEAFTER date of the Dead Diode reference file. Because the file is created after the diode has died, there will be some lag between the time the diode died and the time the reference file is installed in the CDBS and Post-Observation Data Processing System (PODPS). Data taken during this lag time will be calibrated with the incorrect Dead Diode reference file. Announcements of the new appropriate Dead Diode reference file will be posted on STEIS and sent to the Principal Investigators.

Dead diodes are still disabled onboard the spacecraft. Because there is usually a month delay in commanding the diode onboard, there is a chance that data will be calibrated with the incorrect reference file if the dead diode is intermittently dead (see Column 3 in Tables 4.1 and 4.2). The reason for the delay in the onboard command to disable the diode is due to the method and timing of command changes.

Since dead diodes are easier to correct than noisy diodes, intermittent dead diodes are monitored. They aren't disabled until they "completely die" or become frequently intermittent. The effects of an intermittent dead diode can be corrected by using a "temporary" Dead Diode reference file with the particular diode disabled, by using the IRAF task **fixpix** and the equation on page 2 to manually correct the pixel values, or by using the STSDAS task **fixdiodes** (when it becomes available).

Disabling noisy diodes is a different case. The Dead Diode reference file has to coincide with the date the diodes are disabled onboard the spacecraft, usually at the beginning of a Science Mission Schedule (SMS). The date the diode is to be disabled becomes the USEAFTER date. The reference file is delivered to CDBS and PODPS in time so no data need to be recalibrated. There is usually a delay of at least a month between the decision to disable a diode and the actual disable date.

Since some diodes are intermittently noisy (even between different groups of a RAPID observation), they are not automatically disabled when they act up. The FOS calibration team generally follows the "three strikes and you're out" rule - diodes have to be reported noisy at least three times before being disabled. However other factors such as: frequency of noisiness, amplitude of noisiness, and proximity to other disabled diodes are also taken into account. The discriminator noise level may even be adjusted (see CAL/FOS-50, 51, 74, and 100) before a diode is disabled. Some noisy diodes have even been "re-enabled", though most had to be disabled again (see Tables 4.1 and 4.2). Tables 3.1 and 3.2, column 3, shows the current list of diodes under observation.

V. Availability of this Information and Updates

Periodically updated ASCII text and Postscript versions of Tables 1, 2, 3.1, and 3.2 will be maintained in the /instrument_news/fos directory on STEIS and will be available for anonymous

ftp from *stsci.edu*. The files will be named "dead_diode_tables_*mmmyy*.ps" and "dead_diode_tables_*mmmyy*.txt", where the extension "ps" indicates the Postscript version, the extension "txt" denotes the ASCII version, and "*mmmyy*" is the posting date in month and year. For example, the first files posted are "dead_diode_tables_aug94.ps" and "dead_diode_tables_aug94.txt". There will also be announcements posted for new dead diodes (since data may have to be recalibrated) in the same /instrument_news/fos directory.

You can also use the STSDAS task **getreffile** to list the recommended reference files and tables for a particular observation. The Calibration Reference screens in StarView will also list the recommended reference files for an observation dataset (see HST Data Handbook, "Identifying the Best Files Using StarView", page 71). If you are still unsure you are using the correct Dead Diode reference file, please contact Research Support Branch Analysis Hot Line (telephone: (410) 338-1082 or e-mail: *analysis@stsci.edu*).

References

Cohen, R.D. and Beaver, E.A., 1990, Instrument Science Report CAL/FOS-050.

Cohen, R.D., Tudhope, D.S., and Beaver, E.A., 1989, Instrument Science Report CAL/FOS-051.

Cohen, R.D., 1992, Instrument Science Report CAL/FOS-074.

Koratkar, A.P., 1994, "HST Data Handbook (ed. S. Baum)".

Taylor, C.J and Kinney, A.L., 1994, CAL/FOS-100.

Taylor, C.J. and Keyes, C.D., 1994, Instrument Science Report CAL/FOS-113.

Figure Captions

Figure 1: Figure 1a is the raw data file (.d0h). The disabled diodes are labeled 1-20. Figure 1b is the calibrated count rate file (.c4h) with an incorrect Dead Diode reference file. Diodes "2", "3", and "5" are disabled onboard the spacecraft but not in the reference file. Diode "6a" is enabled onboard the spacecraft but disabled in the reference file. Figure 1c shows the calibrated count rate file with the correct Dead Diode reference file.

Figure 2: Figure 2 is an example of a noisy diode. Pixels 400-420 show the noisy diode.

RECOMMENDED FOS DEAD DIODE REFERENCE FILES

Table 1: AMBER DEAD DIODE REFERENCE FILES

Filename	Begin Date (USEAFTER)	End Date	Diodes Disabled on 0-511 scale
c5s1508ay.r4h	24 April 1990	26 Aug 1990	2,6,212,235,261,285,344,381,405,409,486
c5s15086y.r4h	27 Aug 1990	13 Sept 1990	2,6,212,285,405,409,486
c5s15083y.r4h	14 Sept 1990	14 Dec 1990	2,6,110,212,285,405,409,486
c5s15084y.r4h	15 Dec 1990	26 Oct 1991	2,6,110,197,212,285,405,409,486
c5s15088y.r4h	27 Oct 1991	13 Dec 1991	2,6,29,110,197,212,285,405,409,486
c5s15080y.r4h	14 Dec 1991	2 Aug 1992	2,6,29,110,189,197,212,285,405,409,486
c861559ay.r4h	3 Aug 1992	10 Oct 1993	2,6,29,110,189,197,212,285,380,405,409,486
da80843ny.r4h	11 Oct 1993	11 Oct 1993	2,6,29,110,189,197,212,285,380,381,405,409,412,486
dap1024ay.r4h	12 Oct 1993		2,6,29,110,189,197,212,285,308,380,381,405,409,412,486

Table 2: BLUE DEAD DIODE REFERENCE FILES

Filename	Begin Date (USEAFTER)	End Date	Diodes Disabled on 0-511 scale
c6q16023y.r4h	24 April 1990	17 May 1990	47,49,55,73,201,218,219,223,268,284,409,415,427,451,465,472
c6q1601jy.r4H	18 May 1990	10 June 1990	47,49,55,73,201,218,219,223,225,268,284,409,415,427,451,465,472
c6q1601gy.r4h	11 June 1990	31 Oct 1990	47,49,55,73,201,218,219,223,268,284,409,415,427,451,465,472
c6q1601dy.r4h	1 Nov 1990	19 Feb 1991	31,47,49,55,73,201,218,219,223,225,235,241,268,284,409,415,427,451,465,472,497
c6q1601ny.r4h	20 Feb 1991	31 May 1991	31,47,49,55,73,201,218,223,225,235,241,268,284,398,409,451,465,472,497
c6q16019y.r4h	1 June 1991	19 June 1991	31,47,49,55,73,201,218,223,225,235,241,268,284,398,409,451,465,471,472,497
c6q1601ry.r4h	20 June 1991	27 Aug 1991	31,47,49,55,73,201,218,223,225,235,241,268,284,398,409,441,451,465,471,472,497
c6q16020y.r4h	28 Aug 1991	12 April 1992	31,47,49,55,73,101,201,218,223,225,235,241,268,284,398,409,441,451,465,471,472,497
c6p1432my.r4h	13 April 1992	14 Feb 1993	31,47,49,55,73,101,201,218,223,225,235,241,268,284,398,409,427,441,451,465,471,472,497
d2a16223y.r4h	15 Feb 1993	2 May 1993	31,47,49,55,73,101,201,218,223,225,235,241,268,284,398,409,415,427,441,451,465,471,472,497
d4s1044fy.r4h	3 May 1993	6 Sept 1993	31,47,49,55,73,101,144,201,218,223,225,235,241,268,284,398,409,415,427,441,451,465,471,472,497
das1303py.r4h	7 Sept 1993	16 Sept 1993	31,47,49,55,73,101,144,201,218,223,225,235,241,268,284,292,398,409,415,427,441,451,465,471,472,497
d9h1244ay.r4h	17 Sept 1993		31,47,49,55,73,101,144,201,218,223,225,235,241,268,284,292,398,409,415,427,441,451,465,471,472,497

FOS DEAD AND NOISY DIODE SUMMARY

(updated: 7/29/94 C.Taylor. **Diode range is 0-511.**)

Table 3.1: BLUE DETECTOR

DISABLED Dead Diodes	DISABLED Noisy Diodes	DISABLED Cross-Wired Diodes	ENABLED But Possibly Noisy
49	31	47	8
101	73	55	138
223	144		139
284	201		209/210
292	218		421
409	225		426
441	235		
471	241		
	268		
	398		
	415		
	427		
	451		
	465		
	472		
	497		
8	16	2	6

Total Blue Disabled: 26

Table 3.2:AMBER DETECTOR

DISABLED Dead Diodes	DISABLED Noisy Diodes	ENABLED But Possibly Noisy	ENABLED But Intermittent DEAD
2	110	114	97
6	189	142	
29	285	153	
197	380	174	
212	381	258/259	
308	405	261	
486	409	410	
	412		
7	8	7	1

Total Amber Disabled: 15

FOS DEAD AND NOISY DIODES HISTORY

(updated: 10/25/93 C.Taylor **Diode range 0-511**).

Table 4.1: BLUE DETECTOR

DISABLED Dead Diodes	DATE Died	DATE Disabled
49	2/17/88	2/17/88
101	8/28/91	12/14/91
223	4/6/88	4/6/88
284	2/17/88	2/17/88
292	9/7/93	12/10/93
409	2/17/88	2/17/88
441	6/20/91	8/3/91
471	6/1/91	8/3/91

DISABLED Noisy Diodes	DATE Noticed	DATE Disabled
31	3/11/88	11/1/90
73	Prelaunch	Prelaunch
144	3/17/93	5/3/93
201	Prelaunch	Prelaunch
218	Prelaunch	Prelaunch
225	Prelaunch,?	5/18/90,(enabled 6/11/90),11/1/90
235	10/1/90	11/1/90
241	10/3/90	11/1/90
268	Prelaunch	Prelaunch
398	12/90	2/20/91
415	Prelaunch,10/92	Prelaunch,(enabled 2/20/91), 2/15/93
427	Prelaunch, 3/5/92	Prelaunch,(enabled 2/20/91),4/13/92
451	Prelaunch	Prelaunch
465	Prelaunch	Prelaunch
472	Prelaunch	Prelaunch
497	3/11/88	11/1/90
219	Prelaunch	Prelaunch,ENABLED 2/20/91

Table 4.2: AMBER DETECTOR

DISABLED Dead Diodes	DATE Died	DATE Disabled
2	Prelaunch	Prelaunch
6	Prelaunch	Prelaunch
29	10/27/91	1/7/92
197	12/90	2/20/91
212	Prelaunch	Prelaunch
308	10/12/93	12/13/93
486	Prelaunch	Prelaunch

DISABLED Noisy Diodes	DATE Noticed	DATE Disabled
110	7/16/90	9/14/90
189	9/91	12/14/91
285	Prelaunch	Prelaunch (formerly DEAD)
380	7/91	8/3/92
381	Prelaunch,5/93	Prelaunch,(enabled 8/27/90),10/11/93
405	Prelaunch	Prelaunch
409	Prelaunch	Prelaunch
412	11/91	10/11/93
235	Prelaunch	Prelaunch,ENABLED 8/27/90
261	Prelaunch	Prelaunch,ENABLED 8/27/90
344	Prelaunch	Prelaunch,ENABLED 8/27/90

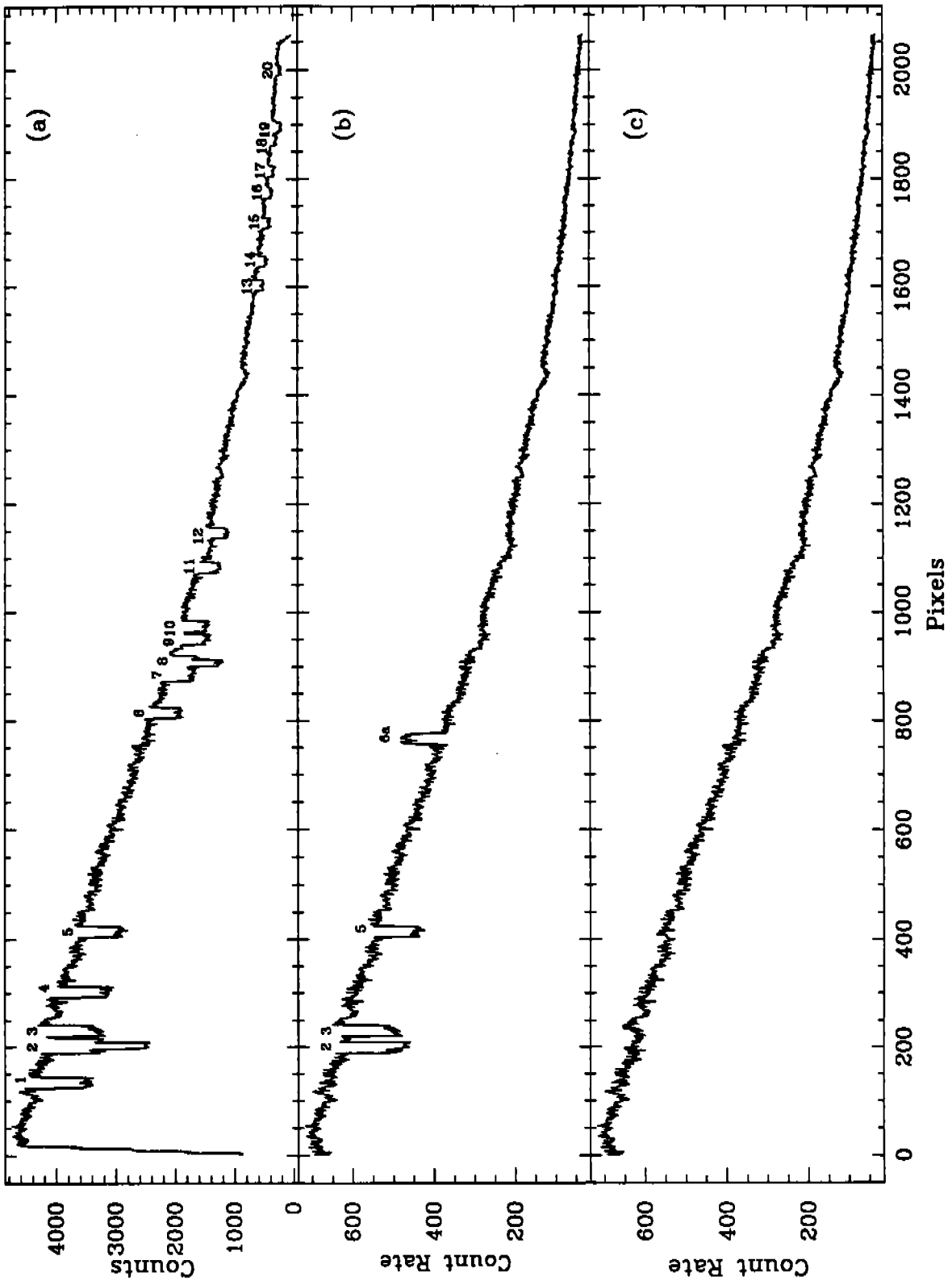

Fig. 1 Example of incorrect dead diode ref file

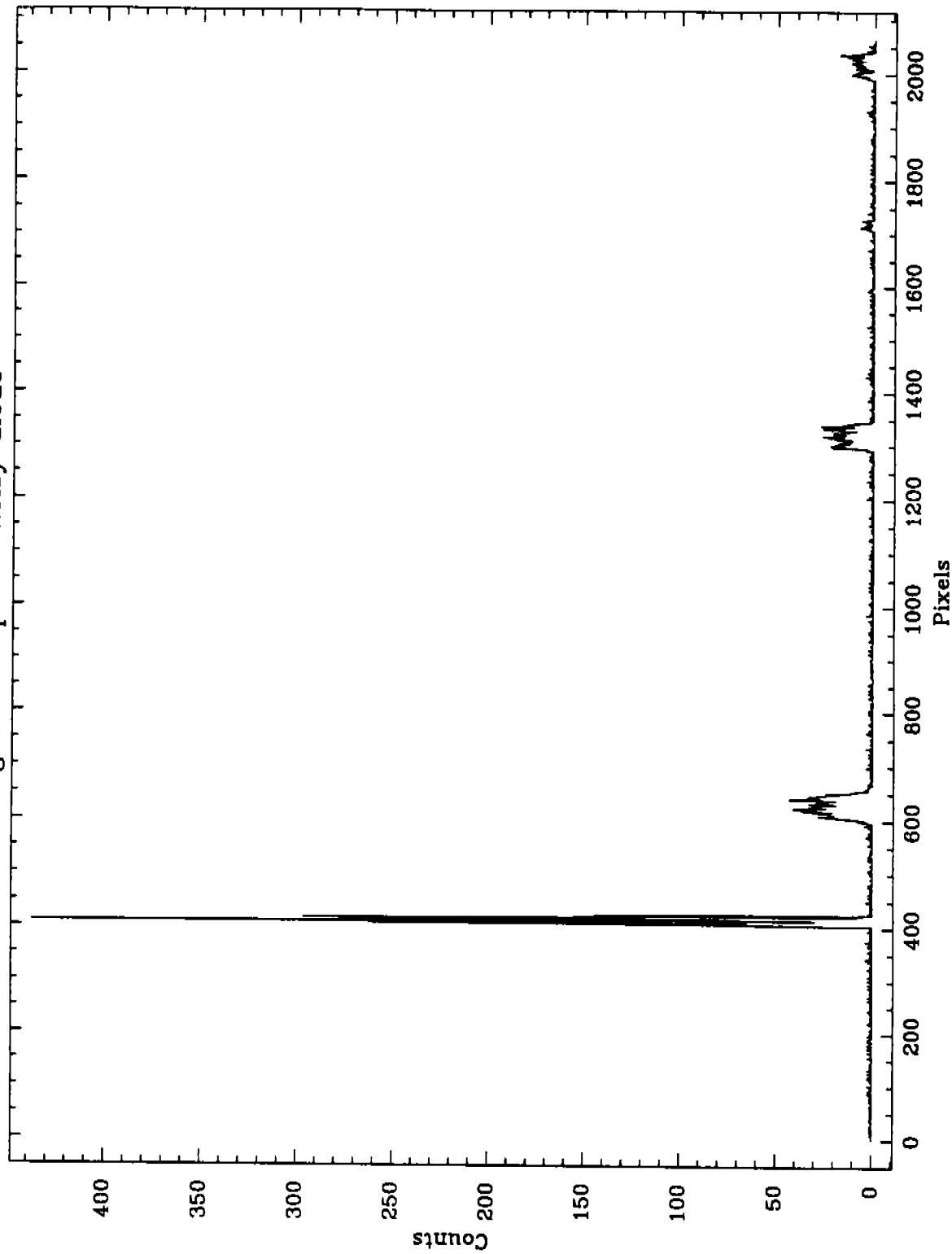

Fig. 2 Example of noisy diode