

#289

OSO-3

REDUCED SPECTROMETER

67-020A-05A

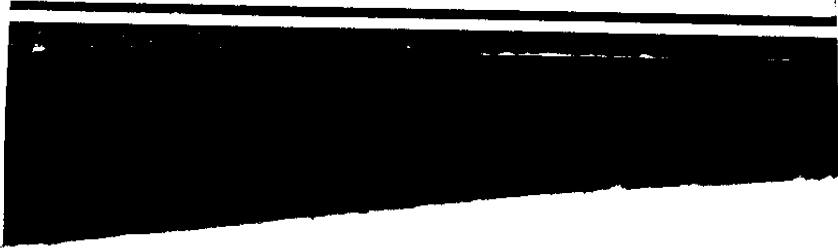


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1. INTRODUCTION:

The documentation for this data set was originally on paper, kept in NSSDC's Data Set Catalogs (DSCs). The paper documentation in the Data Set Catalogs have been made into digital images, and then collected into a single PDF file for each Data Set Catalog. The inventory information in these DSCs is current as of July 1, 2004. This inventory information is now no longer maintained in the DSCs, but is now managed in the inventory part of the NSSDC information system. The information existing in the DSCs is now not needed for locating the data files, but we did not remove that inventory information.

The offline tape datasets have now been migrated from the original magnetic tape to Archival Information Packages (AIP's).

A prior restoration may have been done on data sets, if a requestor of this data set has questions; they should send an inquiry to the request office to see if additional information exists.

2. ERRATA/CHANGE LOG:

NOTE: Changes are made in a text box, and will show up that way when displayed on screen with a PDF reader.

When printing, special settings may be required to make the text box appear on the printed output.

Version	Date	Person	Page	Description of Change
01				
02				

3 LINKS TO RELEVANT INFORMATION IN THE ONLINE NSSDC
INFORMATION SYSTEM:

<http://nssdc.gsfc.nasa.gov/nmc/>

[NOTE: This link will take you to the main page of the NSSDC Master Catalog. There you will be able to perform searches to find additional information]

4. CATALOG MATERIALS:

- a. Associated Documents To find associated documents you will need to know the document ID number and then click here.
<http://nssdcftp.gsfc.nasa.gov/miscellaneous/documents/>

- b. Core Catalog Materials

Reduced Spectrometer Data Tape

67-020A-05A

SOXR-00056

This data set has been restored. The original tapes were 1600 BPI, binary, 9-track. The tapes were created on the 360 computer.

The DR and DS tape is 9-track, binary and is multi-filed. The DR tape is a 3480 cartridge and the DS tape is 6250 BPI.

The DR, DS, and DD numbers along with the time spans are given as follows:

DR#	DS#	DD#	FILES	TIME SPAN
DR02777	DS02777	D-16040	1-79	03/08/67 - 03/15/67
		D-16035	80-178	03/11/67 - 04/04/67
		D-16038	179-279	03/15/67 - 03/21/67
		D-16039	280-384	03/21/67 - 03/28/67
		D-16036	385-486	04/04/67 - 04/10/67
		D-16037	487-584	04/10/67 - 04/17/67
		D-16032	585-687	04/17/67 - 04/24/67
		D-16033	688-787	04/24/67 - 04/30/67
		D-16034	788-893	04/30/67 - 05/07/67
		D-16030	894-999	05/13/67 - 05/20/67
		D-16031	1000-1100	05/20/67 - 05/27/67
		D-16024	1101-1202	05/28/67 - 06/03/67
		D-16025	1203-1355	06/02/67 - 06/12/67
DR02798	DS02798	D-16026	1-157	06/12/67 - 06/22/67
		D-16027	158-264	06/22/67 - 06/29/67
		D-16028	265-366	06/29/67 - 07/05/67
		D-15989	367-469	07/06/67 - 07/12/67
		D-15990	470-577	07/12/67 - 07/19/67
		D-15991	578-684	07/25/67 - 08/01/67
		D-15986	685-789	08/01/67 - 08/08/67
		D-15987	790-948	08/08/67 - 08/18/67
		D-15988	949-1078	08/18/67 - 08/26/67
		D-15983	1079-1207	08/26/67 - 09/03/67
		D-15984	1208-1356	09/03/67 - 09/14/67
DR02799	DS02799	D-15985	1-157	09/14/67 - 09/23/67
		D-15980	158-167	09/23/67 - 09/24/67
		D-15981	168-250	09/24/67 - 09/30/67
		D-15982	251-351	09/30/67 - 10/06/67
		D-15977	352-450	10/06/67 - 10/13/67
		D-15978	451-569	10/13/67 - 10/21/67
		D-15979	570-659	10/21/67 - 10/23/67
		D-15975	660-761	10/26/67 - 11/02/67
		D-15976	762-863	11/02/67 - 11/08/67
		D-16008	864-966	11/09/67 - 11/10/67
		D-16005	967-1071	11/22/67 - 11/28/67
		D-16006	1072-1174	11/28/67 - 12/05/67
		D-16007	1175-1281	12/05/67 - 12/12/67
		D-16002	1282-1386	12/12/67 - 12/18/67

DR#	DS#	DD#	FILES	TIME SPAN
DR02800	DS02800	D-16003	1-102	12/18/67 - 12/25/67
		D-16004	103-201	12/25/67 - 12/31/67
		D-15999	202-306	01/01/68 - 01/07/68
		D-16000	307-410	01/07/68 - 01/14/68
		D-16001	411-513	01/14/68 - 01/20/68
		D-15996	514-617	01/20/68 - 01/27/68
		D-15997	618-718	01/27/68 - 02/03/68
		D-15998	719-822	02/03/68 - 02/09/68
		D-15994	823-920	02/09/68 - 02/16/68
		D-15995	921-1023	02/16/68 - 02/23/68
		D-15992	1024-1131	02/23/68 - 02/29/68
		D-15993	1132-1230	02/29/68 - 03/07/68
DR02806	DS02806	D-16085	1-104	03/07/68 - 03/13/68
		D-16086	105-208	03/13/68 - 03/20/68
		D-16083	209-311	03/20/68 - 03/27/68
		D-16084	312-417	03/27/68 - 04/02/68
		D-16082	418-524	04/09/68 - 04/16/68
		D-16079	525-630	04/16/68 - 04/22/68
		* D-16081	631-735	04/02/68 - 04/09/68
		D-16080	736-837	04/22/68 - 04/29/68
		D-16077	838-942	04/29/68 - 05/05/68
		D-16078	943-1047	05/05/68 - 05/12/68
		D-16075	1048-1152	05/12/68 - 05/19/68
		D-16076	1153-1255	05/19/68 - 05/25/68
		D-16073	1256-1357	05/25/68 - 06/01/68
DR02807	DS02807	D-16074	1-106	06/01/68 - 06/08/68
		D-16070	107-211	06/08/68 - 06/14/68
		D-16071	212-317	06/14/68 - 06/21/68
		D-16072	318-432	06/21/68 - 06/28/68
		D-15960	433-557	06/29/68 - 07/04/68
		D-15957	558-716	07/04/68 - 07/09/68
		D-15958	717-794	07/11/68 - 07/13/68
		D-15959	795-858	07/13/68 - 07/14/68
		D-15954	859-938	07/15/68 - 07/17/68
		D-15955	939-1018	07/17/68 - 07/19/68
		D-15956	1019-1098	07/19/68 - 07/21/68
		D-15951	1099-1178	07/21/68 - 07/23/68
		D-15952	1179-1258	07/24/68 - 07/26/68
		D-15953	1259-1338	07/26/68 - 07/28/68
		D-15950	1339-1418	07/28/68 - 07/30/68
		D-15945	1419-1577	07/31/68 - 08/04/68
		D-15946	1578-1664	08/04/68 - 08/06/68

* THIS FILE OUT OF TIME SEQUENCE

<u>DT</u>	<u>C#</u>	<u>FILES</u>	<u>TIME SPAN</u>
D-15945	C-13093	159	7/31/68 - 8/04/68
D-15946	C-13094	87	8/04/68 - 8/06/68
D-15950	C-13095	80	7/28/68 - 7/30/68
D-15951	C-13096	80	7/21/68 - 7/23/68
D-15952	C-13097	80	7/24/68 - 7/26/68
D-15953	C-13098	80	7/26/68 - 7/28/68
D-15954	C-13099	80	7/15/68 - 7/17/68
D-15955	C-13100	80	7/17/68 - 7/19/68
D-15956	C-13101	80	7/19/68 - 7/21/68
D-15957	C-13102	159	7/04/68 - 7/09/68
D-15958	C-13103	78	7/11/68 - 7/13/68
D-15959	C-13104	64	7/13/68 - 7/14/68
D-15960	C-13105	125	6/29/68 - 7/04/68
D-15975	C-13106	106	10/26/67 - 11/02/67
D-15976	C-13107	102	11/02/67 - 11/08/67
D-15977	C-13108	99	10/06/67 - 10/13/67
D-15978	C-13109	119	10/13/67 - 10/21/67
D-15979	C-13110	90	10/21/67 - 10/23/67
D-15980	C-13111	10	9/23/67 - 4/26/67
D-15981	C-13112	85	9/24/67 - 9/30/67
D-15982	C-13113	102	9/30/67 - 10/06/67
D-15983	C-13114	129	8/26/67 - 9/03/67
D-15984	C-13115	149	9/03/67 - 9/14/67
D-15985	C-13116	157	9/14/67 - 9/23/67
D-15986	C-13117	107	8/01/67 - 8/08/67
D-15987	C-13118	160	8/08/67 - 8/18/67
D-15988	C-13119	130	8/18/67 - 8/26/67

<u>D#</u>	<u>C#</u>	<u>FILES</u>	<u>TIME SPAN</u>
D-15989	C-13120	103	7/06/67 - 7/12/67
D-15990	C-13121	108	7/12/67 - 7/19/67
D-15991	C-13122	107	7/25/67 - 8/01/67
D-15992	C-13123	108	2/23/68 - 2/29/68
D-15993	C-13124	99	2/29/68 - 3/07/68
D-15994	C-13125	98	2/09/68 - 2/16/68
D-15995	C-13126	103	2/16/68 - 2/23/68
D-15996	C-13127	104	1/20/68 - 1/27/68
D-15997	C-13128	101	1/27/68 - 2/03/68
D-15998	C-13129	104	2/03/68 - 2/09/68
D-15999	C-13130	105	1/01/68 - 1/07/68
D-16000	C-13131	104	1/07/68 - 1/14/68
D-16001	C-13132	103	1/14/68 - 1/20/68
D-16002	C-13133	105	12/12/67 - 12/18/67
D-16003	C-13134	102	12/18/67 - 12/25/67
D-16004	C-13135	99	12/25/67 - 12/31/67
D-16005	C-13136	105	11/22/67 - 11/28/67
D-16006	C-13137	103	11/28/67 - 12/05/67
D-16007	C-13138	107	12/05/67 - 12/12/67
D-16008	C-13355	103	11/09/67 - 11/10/67
D-16024	C-13356	102	5/28/67 - 6/03/67
D-16025	C-13357	160	6/02/67 - 6/12/67
D-16026	C-13358	160	6/12/67 - 6/22/67
D-16027	C-13359	108	6/22/67 - 6/29/67
D-16028	C-13360	102	6/29/67 - 7/05/67
D-16029	rel 9/25/69		
D-16030	C-13361	106	5/13/67 - 5/20/67

<u>D#</u>	<u>v C#</u>	<u>FILES</u>	<u>TIME SPAN</u>
D-16031	C-13362	101	5/20/67 - 5/27/67
D-16032	C-13363	103	4/17/67 - 4/24/67
D-16033	C-13364	100	4/24/67 - 4/30/67
D-16034	C-13365	106	4/30/67 - 5/07/67
D-16035	C-13366	102	3/11/67 - 4/04/67
D-16036	C-13367	105	4/04/67 - 4/10/67
D-16037	C-13368	98	4/10/67 - 4/17/67
D-16038	C-13369	105	3/15/67 - 3/21/67
D-16039	C-13370	105	3/21/67 - 3/28/67
D-16040	C-13371	92	3/08/67 - 3/15/67
D-16070	C-13476	105	6/08/68 - 6/14/68
D-16071	C-13477	106	6/14/68 - 6/21/68
D-16072	C-13478	115	6/21/68 - 6/28/68
D-16073	¹³⁴⁷⁹ C-13474	102	5/25/68 - 6/01/68
D-16074	C-13480	106	6/01/68 - 6/08/68
D-16075	C-13481	105	5/12/68 - 5/19/68
D-16076	C-13482	103	5/19/68 - 5/25/68
D-16077	C-13483	105	4/29/68 - 5/05/68
D-16078	C-13484	105	5/05/68 - 5/12/68
D-16079	C-13485	106	4/16/68 - 4/22/68
D-16080	C-13486	102	4/22/68 - 4/29/68
D-16081	C-13487	105	4/02/68 - 4/09/68
D-16082	C-13488	107	4/09/68 - 4/16/68
D-16083	C-13489	103	3/20/68 - 3/27/68
D-16084	C-13490	106	3/27/68 - 4/02/68
D-16085	C-13491	104	3/07/68 - 3/13/68
D-16086	C-13492	104	3/13/68 - 3/20/68

67-020A-05A
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October 8, 1974

Dear Chuck:

The next page is the ~~a~~ modified page 4 of the OSO-3 User's Guide. If you replace page 4 with this one in the version I previously sent you, your Guide will be the same as the new version that is also included.

We now consider this version as the User's Guide.

Paul Takeda

INSTRUMENTS

1.3 to 3.1Å LiF Bragg Spectrometer (Also referred to as one-half of a double spectrometer. Two single spectrometers shared the same drive mechanism. The other half of the double spectrometer did not function properly).

The LiF crystal has a 2d spacing of 4.07Å and a rocking curve with FWHM of about 16 arc minutes.

Monochromatic radiation is reflected from a crystal over a finite range of angles about the Bragg angle. This range of angles is extremely small (seconds of arc) for many crystals. This range of angles (often called the rocking curve) has been increased by mechanical abrasion to produce a mosaic crystal.

The crystal was rotated by 0.1416° per step from 12° to 45° . The detector was rotated at $.2832^\circ$ per step. Stepping occurred during data readout. Data was usually accumulated over 0.58 sec and readout every 0.64 sec.

6 to 25Å KAP Bragg Spectrometer (Also referred to as single spectrometer).

The KAP crystal has a 2d spacing of 26.64Å and a rocking curve with FWHM that varied from 1 arc min near 6Å to about 4 arc min near 20Å. The crystal was rotated by 0.1110° per step from 12° to 72° . The detector was rotated by 0.2220° per step. Stepping occurred during data readout. Data was usually accumulated over 0.62 sec and readout every 0.64 sec.

Grating Spectrometer.

The exit slit before the detector was 28 microns wide and 2 cm high. The exit slit and detector were moved in constant steps along the Rowland circle. Stepping occurred during readout. Data was usually accumulated over 0.28 sec and readout every 0.32 sec.

Sept 11, 1974

Dear Chuck -

Enclosed is a preliminary draft of the user's guide for the spectrometers on OSO-3.

We are looking for comments on completeness, accuracy, and sufficiency from a number of sources including yourself. Would appreciate such comments.

We do not expect very large changes from this draft.

Paul Tinkler

DATA USER'S GUIDE

OSO-3

EUV AND X-RAY SPECTROMETERS

INTRODUCTION

OSO-3 was launched on March 7, 1967 into a near circular orbit with apogee of 570 km, perigee of 549 km, inclination of 32.3 degrees, and a period of 96 minutes.

The XUV spectrometers and ion chambers described here were pointed within 1 arc min of the center of the sun and viewed the entire solar disk and the inner corona.

The instrumentation (see Figure 1) used consists of two uncollimated single crystal Bragg spectrometers, a grazing incidence grating spectrometer and a broad-band ($0.5\text{\AA}$ - $8\text{\AA}$) X-ray ionization chamber. The region from $1.3\text{\AA}$ to $3.1\text{\AA}$ is spectrally dispersed by means of a LiF analysing crystal. The radiation diffracted by the crystal is observed with a conventional photomultiplier using a 5-mil Be filter and a NaI conversion phosphor. The spectral resolution of the system is $0.01\text{\AA}$ at $2.0\text{\AA}$. A similar crystal spectrometer using a KAP (Potassium Acid Phthalate) crystal analyses radiation in the region from $6\text{\AA}$ to $25\text{\AA}$. This radiation is detected by a Bendix magnetic electron multiplier which is shielded from unwanted ultraviolet radiation reflected from the crystal by a 2 micron thick filter of polypropylene overcoated with $2000\text{\AA}$ of aluminum. The resolution of this system is $0.05\text{\AA}$ at $10\text{\AA}$.

The grating spectrometer was used to study radiation of longer wavelengths. It uses an original grating ruled in gold (576 lines/mm) on a blank having a one-meter radius of curvature. Incoming radiation passes through an entrance slit having a width of 28 microns, a height of 2 cm and is incident on the grating at an angle of 88° . The diffracted radiations are focussed on the Rowland circle, there to be sensed by a moving

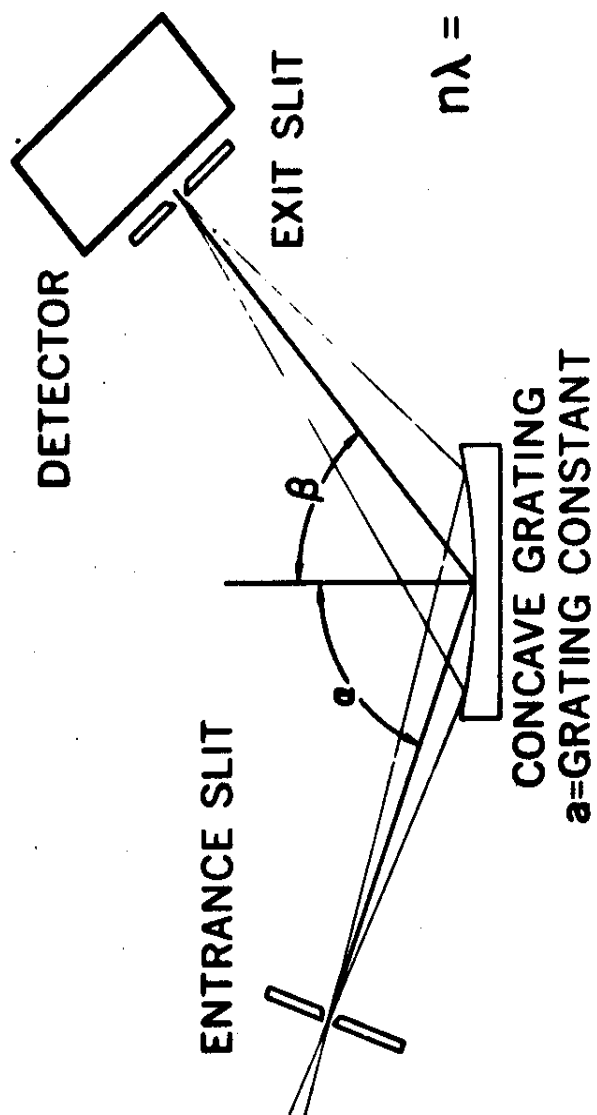
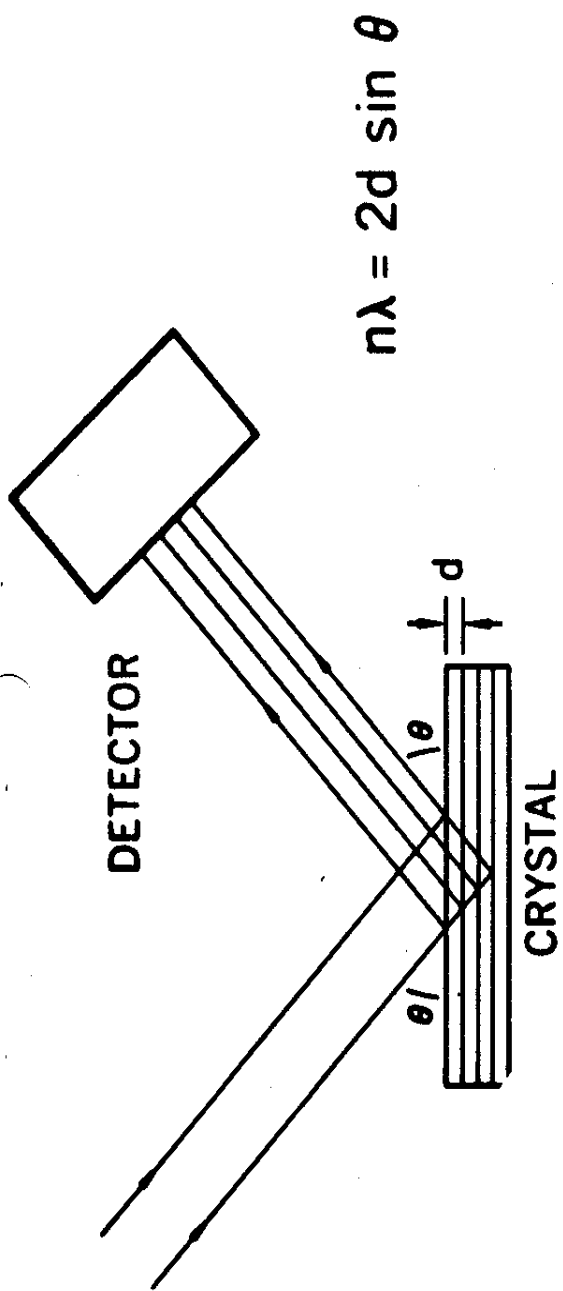


FIGURE 1

exit slit-detector mechanism which is moved along an arc defining the Rowland circle by means of a stepper motor. Motion along this arc corresponds to a spectral scan from $20\text{\AA}$ to $400\text{\AA}$. Spectral resolution is $0.6\text{\AA}$ over this range. Two operational modes are available. Either the entire spectrum from $20\text{\AA}$ to $400\text{\AA}$ can be scanned once every 32 min or 16 min (2 scan rates available) or six preselected intervals of the spectrum, each $4\text{\AA}$ wide, can be scanned with a cycle time of 3 min. The six intervals were chosen to include emission lines of highly ionized iron and also the Ly α (1s-2p transition at $304\text{\AA}$) and Ly β (1s-3p transition at $256\text{\AA}$) lines of ionized helium. The grating spectrometer as well as each of the crystal spectrometers is sensitive to radiation from the entire solar disk and inner corona. In the case of the crystal spectrometers the output for any orientation of the crystal represents a convolution of the spectral and spatial properties of the source. Strong emission lines are sufficiently well separated in wavelength and the size of active regions and X-ray burst events are sufficiently small so that this convolution does not introduce added complexity in the interpretation of the spectrum of a solar X-ray burst.

Scientific results of the observations can be considered as falling into two categories:

(a) Observation of the line emission spectrum associated with solar X-ray bursts.

(b) Observations of the time-histories in selected emission lines during solar X-ray bursts with sufficient temporal resolution to permit comparison with other phenomena such as radio outbursts which may be associated with the event.

INSTRUMENTS

1.3 to 3.1Å LiF Bragg Spectrometer (Also referred to as one-half of a double spectrometer. The other half of the double spectrometer did not function properly).

The LiF crystal has a 2d spacing of $4.07\text{\AA}$ and a rocking curve with FWHM of about 16 arc minutes.

Monochromatic radiation is reflected from a crystal over a finite range of angles about the Bragg angle. This range of angles is extremely small (seconds of arc) for many crystals. This range of angles (often called the rocking curve) has been increased by mechanical abrasion to produce a mosaic crystal.

The crystal was rotated by 0.1416° per step from 12° to 45° . The detector was rotated at $.2832^\circ$ per step. Stepping occurred during data readout. Data was usually accumulated over 0.58 sec and readout every 0.64 sec.

6 to 25Å KAP Bragg Spectrometer (Also referred to as single spectrometer).

The KAP crystal has a 2d spacing of $26.64\text{\AA}$ and a rocking curve with FWHM that varied from 1 arc min near $6\text{\AA}$ to about 4 arc min near $20\text{\AA}$. The crystal was rotated by 0.1110° per step from 12° to 72° . The detector was rotated by 0.2220° per step. Stepping occurred during data readout. Data was usually accumulated over 0.62 sec and readout every 0.64 sec.

Grating Spectrometer.

The exit slit before the detector was 28 microns wide and 2 cm high. The exit slit and detector were moved in constant steps along the Rowland circle. Stepping occurred during readout. Data was usually accumulated over 0.28 sec and readout every 0.32 sec.

.5 to 8Å Ion Chamber.

Two ion chambers with 0.005" Beryllium entrance windows and filled with Xenon gas at 1 atmosphere pressure measure the solar flux over a narrow wavelength range. Window absorption at long λ and gas absorption at short λ determine the wavelength range. Each ion chamber consists of a plated shell and a central wire that is the ion collector. The effective area of the Be windows is 1.0 cm^2 . The outputs of the chambers are connected and fed into an electrometer. The digitized output is read-out every 0.64 seconds. (See White, 1964; Young and Stober, 1966). The second reference has an efficiency curve.

Spectral Scan Modes.

Each instrument is designed to respond to a set of pre-determined programs under the control of the ground command.

The grating spectrometer program is as follows: 25-400 Angstroms, three modes of operation.

Mode 1 will consist of a travel from 400-25 Angstroms at one step per 0.01 seconds, except for the travel of the six segment areas consisting of 64 steps where the speed will be one step at 0.32 seconds. The retrace in this mode will consist of a maximum speed scan that is 0.01 seconds per step. In this mode, the instrument reverses travel and returns to the long wavelength end immediately after scanning the sixth segment.

Mode 2 will consist of a trace and retrace, each having a period of 16.384 minutes, where the speed will be two steps every 0.32 seconds.

Mode 3 will consist of a slow scan from 25-400 Angstroms at one step per 0.32 seconds in 32.768 minutes and a retrace at one step per 0.01 seconds, except for the travel of six segment areas consisting of 64 steps each where the speed will be one step per 0.32 seconds, as in Mode 1.

Data readout is inhibited during the fast scans (0.01 seconds per step).

Total number of steps for the grating spectrometer will be 6,144 approximately.

The double spectrometer program is as follows: 1 to 2.5 Angstroms and 2.5 to 6.4 Angstroms. Three modes of operation:

Mode 1 will consist of a scan in 2.73 minutes and a retrace in the same time, where the speed will be one step every 0.64 seconds.

Mode 2 will consist of a scan in 16.38 minutes and a retrace in the same time, where the speed will be one step every 3.84 seconds.

Mode 3 will consist of a scan in 32.76 minutes and a retrace in the same time, where the speed will be one step every 7.68 seconds.

The total number of steps will be 256 approximately.

The single spectrometer program is as follows: 6.4 to 25 Angstroms; two modes of operation.

Mode 1 will consist of a trace in 5.46 minutes and a retrace in the same time, where the speed will be one step every 0.64 seconds.

Mode 2 will consist of a scan in 21.84 minutes and a retrace in the same time, where the speed will be one step every 2.56 seconds.

The total number of steps will be 512 approximately.

Stationary Mode.

To study time variations of spectral lines, each of the above spectrometers may be set to remain at some preselected step. Readout and data accumulation times remained the same as those given above.

Preselection of a step for a particular line was relatively simple for the grating spectrometer since there was relatively little change in the step location of lines with position on the solar disk.

However, with the crystal spectrometers, preselection required compensation for the location of sources on the solar disk. Spectral studies, the identification of strong lines, and their relative variations with time and location on the solar disk assisted in making the necessary adjustments.

CALIBRATION

Grating Spectrometer

The wavelengths that corresponds to spectrometer settings may be obtained through the location of prominent EUV lines and the grating equation.

The sensitivity of the spectrometer may be obtained by using the results of Chapman and Neupert (1974). In this study, line intensities are given as a function of 2800 MHz radio flux.

Ion Chambers

In the calibration of the ion chambers, total absorption in the gas is assumed for 0.5 to $8\text{\AA}$ photons and 22 ev per ion pair formed is used. The outputs of the two chambers are fed into a single high impedance electrometer. A current sensor selects one of 4 ranges, A, B, C, D,

of the electrometer. The current in any selected range is converted from analog to digital and both the range and digital current value are read-out every 0.64 sec. Conversions of range and digital current value to fluxes are given in the Data Section.

6 to 25Å KAP Bragg Spectrometer.

The wavelength and sensitivity calibrations for a similar instrument on OSO-5 are described in Neupert et al (1973). Both may be used for the KAP spectrometer on OSO-3. The following differences between the instruments may be noted.

1. Stepping increments and the basic time between steps of the OSO-5 instrument were half that of the OSO-3 instrument. Possible resolution of the OSO-5 instrument was better but the scanning rate was the same.
2. The photocathode of the OSO-5 detector had a Cs-I coating while that of OSO-3 did not. The efficiency but probably not the relative spectral efficiency of the OSO-5 detector was probably higher by about 1.5 times.
3. The OSO-3 detector had a filter that consisted of a 2 micron thick sheet of polypropylene that was coated with 2000Å of aluminum. The OSO-5 detector had a filter of 1 micron polypropylene that was coated with 1500Å of aluminum. On OSO-5 only, a similar filter was placed before the entrance window of the spectrometer. The small difference in transmission had little effect on the efficiencies of the instruments. However, the entrance filter of the OSO-5 instrument greatly reduced

the scattered UV background. This occurred for all wavelengths of the spectrometer but was very pronounced at the shorter wavelengths. (See Neupert et al. 1969 and Neupert et al. 1973).

1.3 to 3.1Å LiF Bragg Spectrometer.

For wavelength studies, see Neupert et al., 1967, Neupert et al. 1969, and Neupert et al. 1973. Appendix I gives the result of a study of the sensitivity of the detector.

Time Variations in Sensitivities.

The ionization chamber gave no indication of changes in sensitivity throughout the life of OSO-3. Its readings may be used to obtain approximate changes in sensitivities of the detectors of the two crystal spectrometers. The 10.7 cm solar radio flux and the results of Chapman and Neupert (1974) may be useful in obtaining changes in the sensitivity of the grating spectrometer.

The grating and LiF spectrometers gave useful data for about 9 months before severe deterioration of their detectors. The useful life of the KAP spectrometer was about 6 months.

Background

Charged particle backgrounds due to cosmic rays for all instruments were very small. During occasional traversals of the radiation belts, charged particle background levels became large. Spectral scans and comparisons of variations in ion chamber currents and line radiation are useful in determining background levels. The examination of counts during prior and subsequent orbits are useful indicators of radiation belt passage since these occur about an orbital period apart. The non-occurrence

of events on the sun (Solar Geophysical Data) with temporal variations in ion chamber currents or counting rates is usually an indication of radiation belt traversal.

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INTENSITY CALIBRATION OF THE $\text{LiF}(1-3\text{\AA})$ CRYSTAL SPECTROMETER ABOARD OSO-3

By

K. J. H. Phillips

The intensity calibration of the OSO-3 GSFC $1-3\text{\AA}$ LiF crystal spectrometer was needed for establishing line and continuum fluxes during solar flares. From the fluxes at five locations over the entire $1-3\text{\AA}$ wavelength range to which the instrument is sensitive and well clear of the prominent Fe-line feature at $1.85 - 1.93\text{\AA}$, we determined values for temperature and emission measure ($\int N_e^2 dV$) for hot, flare-produced plasmas (see Phillips, Neupert and Thomas, 1973). In addition, the flux of the $1.9\text{\AA}$ line feature itself was found. For these six locations, values for the crystal-detector combination's efficiency, effective area, energy width of a step and count acceptance time were needed to convert counts per count-acceptance time to photons $\text{cm}^{-2} \text{s}^{-1} \text{keV}^{-1}$.

Let $H(\lambda) = (\text{photons } \text{cm}^{-2} \text{s}^{-1} \text{keV}^{-1})$ per count in a count-accept. period.

Then

$$H(\lambda) = \frac{\Delta\theta}{\eta(\lambda) R(\lambda) A(\lambda) \Delta E(\lambda) \Delta t}$$

where:

$\eta(\lambda)$ = detector efficiency

$R(\lambda)$ = integrated reflectivity coeff. of crystal (rad)

$A(\lambda)$ = effective area (cm^2)

$\Delta E(\lambda)$ = energy width (keV) of a spectrometer step

Δt = count-acceptance time(s)

$\Delta\theta$ = angle corresponding to a spectrometer step (rads)

[$\Delta\theta/\Delta t$ is sometimes called ω , the scanning rate by various authors.]

$\eta(\lambda)$: - The detector is a NaI(Tl) scintillator with a 5-mil-thick Be window. The detecting efficiency of the NaI crystal is practically 100% for 1-3 Å photons, while the transmission of the Be window is $\exp(-\mu \rho d)$ where μ = mass absorption coeff. for Be and $d = \frac{5}{1000} \times 2.54$ cm, the window thickness. Values for μ were taken from Cooke and Stewardson (1964) and are plotted in Figure 1. These values are very similar to those given in the International Tables for X-Ray Crystallography (1962), and not more than 15% different from the results of Henke et al (1967) and Biggs (1963).

$R(\lambda)$: - The integrated reflectivity of the LiF crystal was calculated using the kinematic theory of crystal diffraction as described in (e.g.) Guinier (1963). We chose the "ideally imperfect crystal" case, corresponding to maximum disarray of diffracting elements. This gives

$$R(\lambda) = F \cdot \frac{1 + \cos^2 2\theta}{2 \sin 2\theta} \cdot \frac{1}{2(\mu\rho)_{\text{LiF}}}$$

where θ is the Bragg angle corresponding to first-order diffraction of wavelength λ ($\lambda = 2d \sin \theta$), $(\mu\rho)_{\text{LiF}}$ = mass absorption coefficient x density for Lithium fluoride and F a factor related to the crystal form factor and the diffracting element volume. Values for $(\mu\rho)_{\text{LiF}}$ were taken from the International Tables for X-Ray Crystallography. The calculation agrees with that of Meekins et al (1968). This curve was calculated as a function of λ (and therefore θ). The factor F was not calculated since it depends on the particular parameters of the crystal in question. Rather, we compared the relative value of the $R(\lambda)$ curve until we obtained

reasonable agreement with points measured by Sterk et al (1972). These measured points and the calculated curve are shown in Figure 2.

$A(\lambda)$: - For wavelengths $< 1.95\text{\AA}$, the area of the diffracted beam was less than the detector window, so that the effective area is wavelength-sensitive for $\lambda < 1.94\text{\AA}$. The wavelength dependence is the same as for OSO-5's LiF detector (see Saba (1972) for a plot of $A(\lambda)$).

$\Delta E(\lambda)$ is the spectrometer step size measured in energy units (keV, say).

Δt is the count-acceptance time = $0.64\text{s} - 3 \times \text{time for readout of scalers} = 0.64 - 0.06 = 0.58\text{s}$.

$\Delta\theta$ - Angle corresponding to a spectrometer step = $.00251\text{ rads}$.

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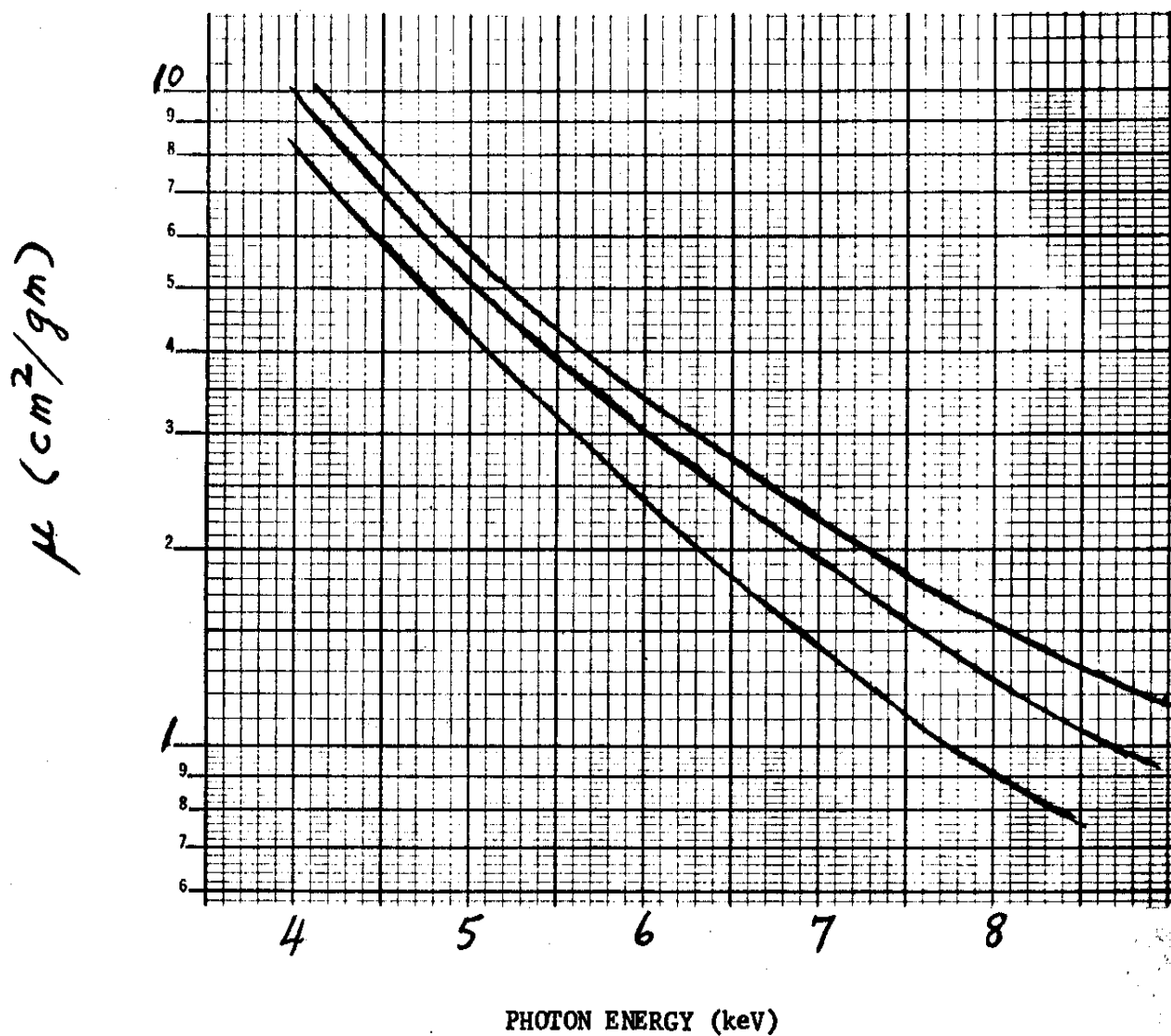


Figure 1. Mass absorption coefficient for Be.

Upper Curve - International tables for x-ray crystallography (1962).

Middle Curve - Cooke and Stewardson (1964) - ADOPTED

Lower Curve - Henke (1967).

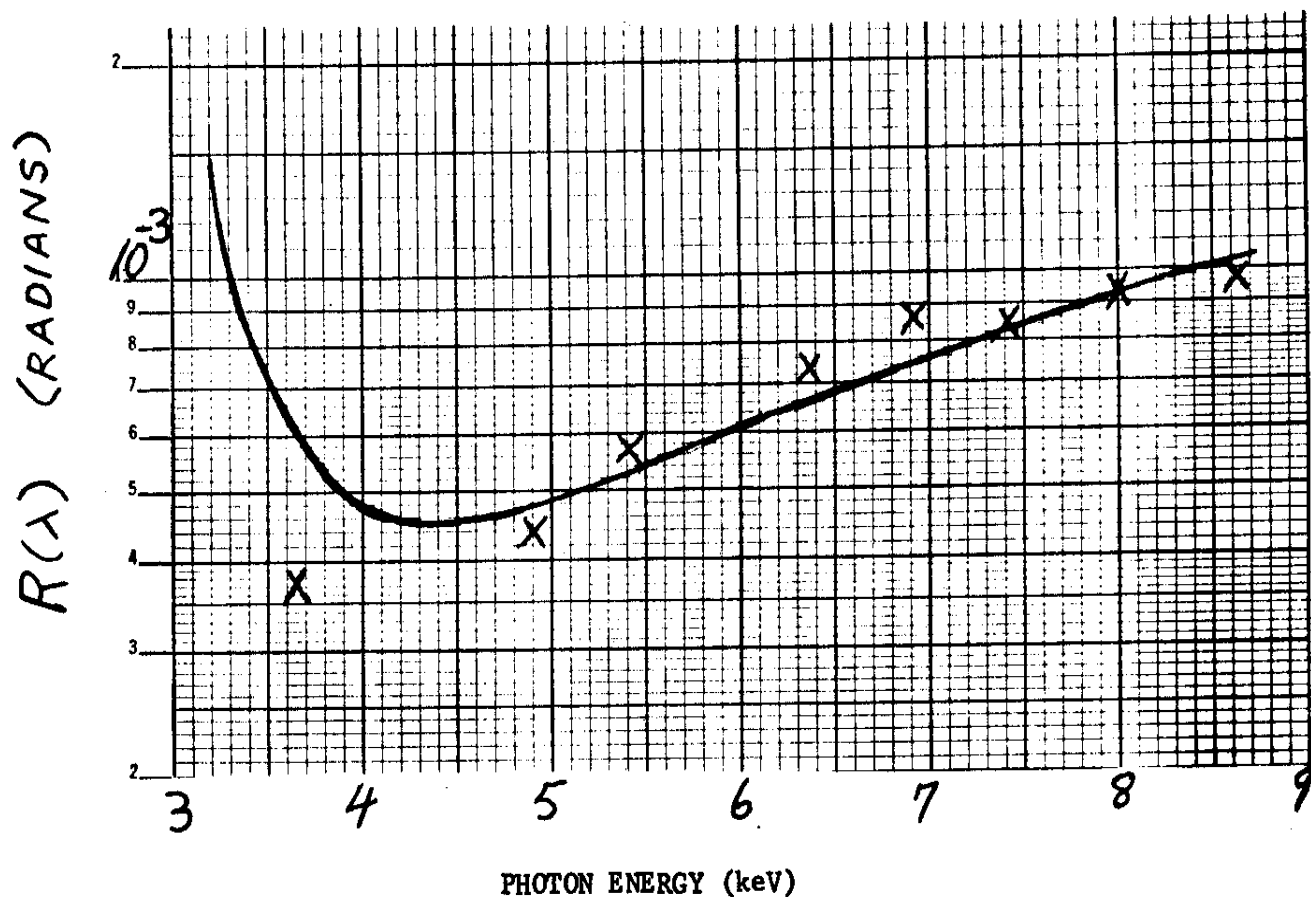


Figure 2. Integrated reflectivity, $R(\lambda)$ for LiF crystal. (Kinematic theory and measured points compared).
Curve forced to agree with measured values of Sterk et al. (1972).

OPERATIONS

From launch on March 7, 1967 until about March 12, 1967, no useful data was collected because of spacecraft checkout.

For about 1 month after March 12, 1967, spectral scans were emphasized.

Thereafter, line monitoring was emphasized with spectral scans taken about once a week.

Listed below are the commands that were used. Following this in chronological order are the commands that were issued.

Following this is a list of times of activity during which significant changes in ion current due to x-rays occurred.

Commands

Command #48 - This command actuates Mode 1 of the grating spectrometer.

Command #49 - This command actuates Mode 2 of the grating spectrometer.

Command #50 - This command actuates Mode 3 of the grating spectrometer.

Command #51 - This command returns the grating spectrometer to its long wavelength limit from whatever position the spectrometer may be in by the shortest possible route (0.01 second per step reverse). Upon reaching the home position, the spectrometer will stop and await the next ground command.

Command #52 - This command returns the grating spectrometer to its short wavelength limit from whatever position the spectrometer may be in by the shortest possible route (0.01 second per step forward). Upon reaching the home position, the spectrometer will stop and await the next ground command.

Command #53 - This command stops the grating spectrometer immediately upon receipt in whatever position it may be and turns on the high voltage.

On receipt of a command (except commands 5 and 6) while traveling in any mode, the grating spectrometer will immediately act on the new command but will continue traveling in the same direction as it was before the command was transmitted.

When it is desired to set the grating spectrometer on a given spectral line, the procedure is to transmit a Command 4, then allow sufficient time for a complete retrace of the spectrometer in the fastest mode (61.44 seconds). After this period has elapsed, a command 5 is transmitted synchronously with the start of a clock; this starts the spectrometer forward. Having calculated the necessary time elapse to complete the number of steps required to reach the desired line, Command 6 is transmitted at the expiration of this time and the spectrometer will stop on the line position.

Command #54 - This command actuates Mode 1 of the double spectrometer.

Command #55 - This command actuates Mode 2 of the double spectrometer.

Command #56 - This command actuates Mode 3 of the double spectrometer.

Command #57 - This command actuates Mode 1 of the single spectrometer.

Command #58 - This command actuates Mode 2 of the single spectrometer.

Command #59 - Flare ready, Modes "off". This command effectively cancels Commands 60, 61, and 62. While this command is stored, the spectrometers will not respond to a flare indication from the ion chamber electronics.

Command #60 - This command is ready flare, Mode "on" for the grating spectrometer. This command is stored by the command memory and upon receipt of a flare signal from the ion chamber electronics, it will automatically put the grating spectrometer into Mode 1.

Command #61 - This command is ready flare, Mode "on" for the double spectrometer. This command is stored by the command memory and upon receipt of a flare signal from the ion chamber electronics, it will automatically put the double spectrometer into Mode 1.

Command #62 - This command is ready flare, Mode "on" for the single spectrometer. This command is stored by the command memory and upon receipt of a flare signal from the ion chamber electronics, it will automatically put the single spectrometer into Mode 1.

The purpose of Commands 60 through 62 is to modify the ground commands stored in the command memory automatically in quick response to a solar flare. Command 59 inhibits this operation.

Command #63 - This command stops the single spectrometer immediately upon receipt in whatever position it may be and turns on the high voltage.

Command #64 - This command stops the double spectrometer immediately upon receipt in whatever position it may be and turns on the high voltage.

Command #92 - This command operates on all three spectrometers in the following manner: It commands the grating spectrometer to Mode 3; the double spectrometer to Mode 3; and the single spectrometer to Mode 2.

A single known as the "playback gate" is received from the satellite electronics during the time that the tape recorder is playing back data to the ground station via the transmitter. At this time, no telemetry readout from the instrument package is possible, since both the tape recorder and the real-time transmitter are employed in this operation. During the period of the "playback gate," all spectrometers are immediately stopped in whatever position they may be and data readout is inhibited. (This is done to conserve power and to preserve continuity of data.) When the "playback gate" goes down, all operations are resumed where they left off except in the instance where a change in command has been received by the command memory during this period when the appropriate instrument would respond to the new instructions.

Command #93 - All high voltage off, squib fired.

Command #94 - High voltage applied on double spectrometer.

GRATING COMMANDS

3	8	17	16	53	0	93	3	18	11	48	44	48	3	25	9	33	52	59
3	8		18	0	4	93	3	19	5	6	16	59	3	26	2	42	15	59
3	9		9	20	15	86	3	19	5	6	17	92	3	26	2	42	16	49
3	9		9	20	16	93	3	19	6	47	15	59	3	26	9	28	20	59
3	9		9	20	17	88	3	19	6	47	16	92	3	27	2	36	15	59
3	9		9	20	18	51	3	19	6	47	17	60	3	27	2	36	16	49
3	9	12	49	5	86		3	19	8	21	30	92	3	27	9	23	15	59
3	9	12	49	6	93		3	19	10	3	30	92	3	28	0	50	15	59
3	9	12	49	15	59		3	19	11	44	15	48	3	28	0	50	16	50
3	9	12	49	16	48		3	20	5	0	15	59	3	28	0	50	19	60
3	9	16	11	30	92		3	20	5	0	16	92	3	28	2	30	15	50
3	12	12	25	40	59		3	20	6	41	15	59	3	28	4	12	50	50
3	12	12	25	42	93		3	20	6	41	16	92	3	28	5	54	15	59
3	12	12	32	20	93		3	20	6	41	17	60	3	28	5	54	16	48
3	12	15	48	30	48		3	20	8	23	15	92	3	29	0	43	15	59
3	12	15	54	50	93		3	20	10	4	15	92	3	29	0	43	16	50
3	12	14	12	50	59		3	20	11	45	11	59	3	29	0	43	19	60
3	13	12	19	0	93		3	20	11	45	12	48	3	29	2	24	15	50
3	13	12	19	1	59		3	21	3	13	23	59	3	29	5	48	15	59
3	13	12	19	7	93		3	21	3	13	24	92	3	29	5	48	16	48
3	13	12	27	30	93		3	21	3	13	25	60	3	31	0	31	20	50
3	13	14	0	25	93		3	21	4	52	52	92	3	31	0	31	21	59
3	13	14	0	30	59		3	21	6	34	0	92	3	31	0	31	22	60
3	14	10	40	20	88		3	21	8	17	30	92	3	31	2	13	20	50
3	14	10	40	21	52		3	21	9	58	0	92	3	31	3	54	30	50
3	14	10	40	23	88		3	21	11	39	20	59	3	31	5	35	15	59
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3	17	5	18	13	59		3	23	4	41	21	49	4	2	22	32	17	60
3	17	5	18	16	50		3	23	6	24	0	92	4	3	0	12	15	50
3	17	8	33	30	59		3	23	8	5	10	92	4	3	1	54	5	50
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3	18	5	5	30	59		3	23	9	46	11	48	4	3	3	36	16	48
3	18	5	5	31	92		3	24	2	54	20	59	4	3	22	26	15	59
3	18	6	45	30	59		3	24	2	54	22	49	4	3	22	26	16	49
3	18	6	45	31	92		3	24	4	35	21	49	4	4	3	31	15	48
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3	18	10	9	20	92		3	24	9	40	10	59	4	5	3	25	15	48
							3	24	9	40	11	49	4	5	20	34	25	59
							3	25	2	48	15	59	4	5	20	34	26	49
							3	25	2	48	16	49	4	6	5	2	15	48

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4	7	20	22	31	49	5	4	10	51	25	88	5	31	20	3	45	88
4	8	1	26	10	48	5	4	10	51	28	86	5	31	20	10	0	86
4	8	18	36	30	59	5	4	10	51	40	88	6	1	18	15	36	93
4	8	18	36	31	49	5	4	12	27	30	86	6	1	18	15	38	93
4	9	1	20	20	48	5	4	14	8	50	88	6	1	18	15	40	53
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5	2	12	45	38	88	5	29	20	22	50	86	6	16	10	5	15	50
5	2	12	45	42	86	5	31	16	3	0	49	6	17	11	29	30	51
5	2	12	48	30	88	5	31	18	21	45	88	6	17	11	30	35	48
5	2	14	20	31	53	5	31	18	22	30	86	6	17	11	30	55	53
5	2	14	20	33	88	5	31	18	23	0	51	6	19	14	43	10	93

6 19	14 43 11	53	8 3	13 34 40	88	9 2	18 31 0	49
6 19	14 43 12	49	8 3	13 41 30	86	9 2	20 43 0	51
6 20	14 34 30	52	8 3	13 41 45	49	9 2	20 44 5	48
6 20	14 35 35	51	8 3	16 56 0	51	9 2	20 44 25	53
6 20	14 35 42	53	8 3	16 57 5	48	9 5	18 43 30	49
6 30	3 31 15	49	8 3	16 57 25	53	9 5	20 23 30	51
6 30	8 38 31	93	8 3	16 58 5	88	9 5	20 24 35	48
6 30	8 38 32	53	8 3	17 4 3	86	9 5	20 24 55	53
6 30	8 38 33	49	8 5	10 5 15	49	9 6	18 5 0	49
6 30	10 9 0	51	8 5	11 39 0	51	9 6	20 17 0	51
6 30	10 10 5	48	8 5	11 40 5	48	9 6	20 18 5	48
6 30	10 10 25	53	8 5	11 40 26	53	9 6	20 18 26	53
7 6	1 6 14	50	8 7	13 15 0	49	9 7	16 50 30	49
7 17	20 25 0	51	8 7	16 31 0	51	9 8	20 4 0	51
7 17	20 26 5	48	8 7	16 32 5	48	9 8	20 5 5	48
7 17	20 26 56	53	8 7	16 32 26	53	9 8	20 6 30	53
7 19	15 6 30	49	8 9	13 3 30	49	9 8	20 6 37	49
7 19	18 31 0	51	8 17	12 5 50	88	9 11	19 45 0	51
7 19	18 32 5	48	8 17	12 12 15	86	9 11	19 46 5	48
7 19	18 32 56	53	8 22	9 56 0	51	9 11	19 46 55	53
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7 21	18 18 0	51	8 25	1 4 35	48	9 14	19 26 25	53
7 21	18 19 5	48	8 25	1 5 26	53	9 14	21 5 40	88
7 21	18 19 56	53	8 28	22 57 0	51	9 14	21 14 20	86
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7 24	19 41 30	51	8 28	22 59 10	48	9 15	17 37 0	93
7 24	19 42 35	48	8 28	22 59 30	53	9 15	17 37 3	53
7 24	19 43 26	53	8 28	22 59 49	49	9 16	12 28 30	49
7 25	16 11 52	88	8 28	22 26 0	49	9 16	14 8 0	51
7 25	16 19 20	86	8 29	0 38 0	51	9 16	14 9 5	48
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7 27	19 23 5	51	8 30	22 44 35	48	9 18	19 0 35	48
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7 31	17 18 38	53	8 31	22 38 34	53	9 19	17 12 5	48
8 2	10 26 0	49	8 31	22 39 44	51	9 19	17 12 55	53
8 2	13 39 30	52	8 31	22 40 31	48	9 19	17 13 45	60
8 2	13 40 35	49	8 31	22 41 21	53	9 19	17 20 48	48
8 2	13 42 39	53	9 1	20 16 0	49	9 19	17 20 49	53
8 2	17 3 0	52	9 1	22 31 0	51	9 20	15 22 30	51
8 2	17 4 5	49	9 1	22 32 5	48	9 20	15 23 35	48
8 2	17 6 12	53	9 1	22 32 25	53	9 20	15 24 26	53

9 20	18 45 45	59	10 11	13 39 5	48	12 12	20 3 26	53
9 20	18 46 0	51	10 14	23 15 0	93	12 19	19 19 0	51
9 20	18 47 5	48	10 15	2 36 50	53	12 19	19 20 5	49
9 20	18 47 55	53	10 15	5 53 30	48	12 19	13 39 0	53
9 20	18 54 15	48	10 22	20 31 30	51	12 19	13 39 5	48
9 20	18 54 16	53	10 22	20 32 35	48	12 21	18 58 30	48
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9 22	16 52 5	48	10 26	20 5 30	51	1 12	10 11 30	52
9 22	16 52 55	53	10 26	20 5 35	48	1 12	10 12 35	49
9 24	3 8 48	60	10 26	20 5 35	53	1 12	11 26 0	51
9 24	14 57 20	49	10 26	18 25 0	49	1 12	11 28 25	48
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9 25	14 50 0	51	11 7	15 22 15	48	1 12	11 27 5	48
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9 27	11 14 0	59	11 9	15 7 31	48	1 14	5 25 0	93
9 27	11 14 1	49	11 9	11 45 30	93	1 14	5 26 0	93
9 27	14 37 0	51	11 9	11 45 31	53	1 14	5 27 0	93
9 27	14 38 5	48	11 9	11 45 32	49	1 14	5 27 30	53
9 27	14 38 25	53	11 13	14 41 30	49	1 14	7 42 0	88
9 28	11 7 0	49	11 13	16 22 30	48	1 14	19 48 0	41
9 28	14 30 30	51	11 25	7 35 30	51	1 14	19 48 40	4
9 28	14 31 35	48	11 25	7 36 35	49	1 14	19 49 0	40
9 28	14 32 25	53	11 25	10 2 30	51	2 5	17 6 5	53
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9 30	0 0 0	49	12 1	0 16 0	51	2 19	17 12 0	51
9 30	12 29 50	59	12 1	0 17 5	49	2 19	17 13 5	49
9 30	12 30 0	51	12 4	22 38 30	93	2 20	11 58 25	51
9 30	12 31 5	48	12 4	22 38 31	53	2 20	11 59 30	48
9 30	12 31 25	53	12 4	22 38 32	49	2 20	12 0 44	53
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10 1	12 23 0	51	12 7	3 30 30	48	2 20	13 42 14	53
10 1	12 24 5	48	12 8	20 30 0	51	2 20	16 57 40	48
10 1	12 24 55	53	12 8	20 31 5	49	2 21	13 26 0	51
10 2	9 1 0	60	12 8	23 52 30	93	2 21	13 27 5	48
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10 2	12 22 50	59	12 8	23 52 34	49	2 21	13 28 30	51
10 2	12 23 0	51	12 9	1 33 0	48	2 21	13 34 30	48
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10 11	13 39 0	53	12 12	20 2 35	48	2 23	11 38 5	51

2 23	11 38 25	53	3 14	22 44 5	53
2 23	13 11 25	51	3 14	22 45 5	93
2 23	13 12 30	48	3 14	22 45 35	53
2 23	13 13 21	53	3 14	22 46 35	93
2 23	13 14 0	51	3 14	22 53 0	53
2 23	13 20 0	48	3 15	2 7 0	88
2 23	13 20 51	53	3 15	20 25 0	86
2 23	15 1 0	51	3 15	21 59 0	93
2 23	15 1 45	48	3 15	22 4 0	53
2 23	15 2 5	53	3 15	23 40 0	93
2 27	9 54 0	51	3 15	23 41 0	53
2 27	9 55 5	48	3 16	1 23 0	93
2 27	11 7 0	51	3 16	1 23 10	53
2 27	11 8 5	49	3 16	2 6 0	48
2 27	12 41 25	51	3 22	21 42 30	51
2 27	12 42 30	48	3 22	21 43 35	48
2 27	12 42 50	53	3 22	21 44 26	53
3 1	17 41 40	88	3 22	21 51 0	48
3 2	3 7 0	86	3 22	21 51 0	53
3 2	10 37 0	51	3 22	23 25 0	51
3 2	10 38 5	50	3 22	23 25 30	48
3 6	2 44 0	52	3 22	23 26 21	53
3 6	2 45 5	51	3 22	23 33 0	48
3 6	2 45 26	53	3 22	23 33 0	53
3 6	4 57 0	48	3 22	23 33 40	48
3 8	1 18 45	51	3 23	19 54 0	51
3 8	1 19 50	49	3 23	19 55 5	48
3 8	4 4 0	52	3 23	19 55 56	53
3 8	4 5 5	51	3 23	23 9 30	48
3 8	4 5 39	53	3 25	23 9 30	48
3 8	6 57 0	51	3 26	16 9 30	51
3 8	6 58 5	48	3 26	16 10 35	48
3 11	23 8 0	51	3 26	16 10 55	53
3 11	23 9 5	48	3 27	16 1 0	51
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3 12	0 49 35	49	3 27	16 2 15	48
3 12	22 59 30	51	3 27	16 2 36	53
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3 12	23 1 57	53	3 28	15 54 45	51
3 13	2 29 0	48	3 28	15 55 50	48
3 13	22 52 0	51	3 28	15 56 11	53
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3 13	22 53 56	53	4 1	13 41 30	49
3 14	11 13 0	51	4 1	15 22 0	51
3 14	11 13 0	49	4 1	15 23 5	48
3 14	21 5 0	51	4 1	15 23 55	53
3 14	21 6 5	48			
3 14	21 6 56	53			
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3 14	21 9 0	88			
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DOUBLE COMMANDS

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3 8 18 0 4 93	3 18 11 48 46 54	3 24 6 19 0 55
3 9 9 20 15 86	3 19 5 6 16 59	3 24 7 59 10 55
3 9 9 20 16 93	3 19 5 6 17 92	3 24 9 40 10 59
3 9 9 20 17 88	3 19 6 47 15 59	3 24 9 40 12 54
3 9 12 49 5 86	3 19 6 47 16 92	3 25 2 48 15 59
3 9 12 49 6 93	3 19 6 47 18 61	3 25 2 48 17 55
3 9 12 49 15 59	3 19 8 21 30 92	3 25 2 48 19 61
3 9 12 49 17 55	3 19 10 3 30 92	3 25 4 29 15 55
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3 12 12 25 42 93	3 20 6 41 15 59	3 25 9 33 53 54
3 12 12 31 50 94	3 20 6 41 16 92	3 26 2 42 15 59
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3 12 15 54 50 93	3 20 8 23 15 92	3 26 2 42 18 55
3 12 14 12 50 59	3 20 10 4 15 92	3 26 2 42 20 61
3 12 14 13 20 54	3 20 11 45 11 59	3 26 4 24 15 55
3 12 14 12 50 94	3 20 11 45 13 54	3 26 6 5 10 55
3 13 12 19 0 93	3 21 3 13 23 59	3 26 7 47 20 55
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3 13 12 19 7 93	3 21 3 13 26 61	3 26 9 28 21 54
3 13 12 27 30 93	3 21 4 52 52 92	3 27 2 36 15 59
3 13 12 27 32 94	3 21 6 34 0 92	3 27 2 36 17 55
3 13 14 0 25 93	3 21 8 17 30 92	3 27 2 36 19 61
3 13 14 0 30 59	3 21 9 58 0 92	3 27 4 18 15 55
3 13 14 1 30 94	3 21 11 39 20 59	3 27 5 59 14 55
3 14 10 40 20 88	3 21 11 39 22 54	3 27 9 23 15 59
3 14 10 40 23 88	3 22 3 7 20 59	3 27 9 23 16 54
3 14 12 13 0 93	3 22 3 7 21 55	3 27 7 41 15 55
3 14 12 14 20 93	3 22 3 7 23 61	3 28 0 50 15 59
3 14 12 21 0 93	3 22 4 47 20 92	3 28 0 50 18 55
3 14 13 54 20 59	3 22 4 47 21 55	3 28 0 50 20 61
3 14 14 2 0 94	3 22 6 29 10 92	3 28 2 30 17 55
3 14 14 2 1 55	3 22 6 29 11 55	3 28 4 12 52 55
3 14 14 2 2 61	3 22 8 10 10 92	3 28 5 54 15 59
3 15 8 54 2 59	3 22 8 10 11 55	3 28 5 54 17 54
3 15 8 54 3 55	3 22 9 52 21 59	3 29 0 43 14 55
3 15 12 10 0 61	3 22 9 53 0 54	3 29 0 43 15 59
3 16 12 2 40 55	3 23 3 1 20 59	3 29 0 43 20 61
3 16 12 9 15 61	3 23 3 1 21 92	3 29 2 24 16 55
3 17 5 18 13 59	3 23 3 1 23 55	3 29 5 48 15 59
3 17 5 18 14 55	3 23 3 1 25 61	3 29 5 48 17 54
3 17 8 33 30 59	3 23 4 41 20 92	3 31 0 31 21 59
3 17 8 33 32 61	3 23 4 41 22 55	3 31 5 35 15 59
3 18 5 5 30 59	3 23 6 24 0 92	4 1 3 48 15 59
3 18 5 5 31 92	3 23 6 24 1 55	4 1 22 38 15 59
3 18 6 45 30 59	3 23 8 5 10 92	4 2 3 42 15 59
3 18 6 45 31 92	3 23 8 5 11 55	4 2 22 32 15 59
3 18 6 45 33 61	3 23 9 46 10 59	4 3 3 36 15 59
3 18 8 27 30 92	3 23 9 46 12 54	4 3 22 26 15 59
	3 24 2 54 20 59	4 3 22 26 17 54
	3 24 2 54 21 55	4 4 20 41 20 59
	3 24 2 54 24 61	4 4 20 41 22 54

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4	15	16	11	33	61	5	5	10	41	10	64	6	14	11	50	42	94
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8 3	16 58 5	88	3 2	3 7 0	86
8 3	17 4 3	86	3 14	21 7 30	93
8 17	12 5 50	88	3 14	21 8 30	94
8 17	12 12 15	86	3 14	21 9 0	88
9 9	21 39 0	54	3 14	21 9 30	86
9 9	21 40 4	64	3 14	22 44 0	93
9 12	17 57 30	54	3 14	22 45 5	93
9 14	21 5 40	88	3 14	22 46 35	93
9 14	21 14 20	86	3 14	22 53 15	94
9 14	21 14 39	64	3 15	2 7 0	88
9 14	21 14 45	93	3 15	20 25 0	86
9 14	21 14 47	64	3 15	21 59 0	93
9 14	21 14 48	94	3 15	22 4 30	94
9 15	17 37 0	93	3 15	23 40 0	93
9 15	17 37 9	94	3 15	23 41 30	94
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9 25	14 52 30	59	3 16	1 24 0	94
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10 1	12 22 50	59			
10 2	12 22 50	59			
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10 11	9 43 30	93			
10 11	13 39 15	94			
10 14	23 15 0	93			
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12 11	20 8 51	93			
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12 11	20 8 51	94			
12 12	8 43 50	54			
12 19	13 39 15	94			
1 14 68	5 24 0	88			
1 14	5 24 10	86			
1 14	5 25 0	93			
1 14	5 25 30	94			
1 14	5 26 0	93			
1 14	5 27 0	93			
1 14	5 28 0	94			
1 14	7 42 0	88			
2 5	17 6 15	94			
3 1	17 41 40	88			

SINGLE COMMANDS

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3 8 18 0 4 93	3 19 5 6 17 92	3 25 9 33 52 59
3 9 9 20 15 86	3 19 6 47 15 59	3 25 9 33 54 57
3 9 9 20 16 93	3 19 6 47 16 92	3 26 2 42 15 59
3 9 9 20 17 88	3 19 6 47 19 62	3 26 2 42 19 58
3 9 12 49 5 86	3 19 8 21 30 92	3 26 2 42 21 62
3 9 12 49 6 93	3 19 10 3 30 92	3 26 4 24 16 58
3 9 12 49 15 59	3 19 11 44 18 57	3 26 6 5 11 58
3 9 12 49 18 57	3 20 5 0 15 59	3 26 7 47 21 58
3 9 16 11 30 92	3 20 5 0 16 92	3 26 9 28 20 59
3 12 12 25 40 59	3 20 6 41 15 59	3 26 9 28 22 57
3 12 12 25 42 93	3 20 6 41 16 92	3 27 2 36 15 59
3 12 12 32 20 93	3 20 6 41 19 62	3 27 2 36 18 58
3 12 15 54 50 93	3 20 8 23 15 92	3 27 2 36 20 62
3 12 14 12 50 59	3 20 10 4 15 92	3 27 4 18 16 58
3 13 12 19 0 93	3 20 11 45 11 59	3 27 5 59 16 58
3 13 12 19 1 59	3 20 11 45 14 57	3 27 9 23 15 59
3 13 12 19 2 63	3 21 3 13 23 59	3 27 9 23 17 57
3 13 12 19 7 93	3 21 3 13 24 92	3 27 7 41 16 58
3 13 12 27 0 63	3 21 3 13 27 62	3 28 0 50 15 59
3 13 12 27 30 93	3 21 4 52 52 92	3 28 0 50 17 58
3 13 14 0 25 93	3 21 6 34 0 92	3 28 0 50 21 62
3 13 14 0 30 59	3 21 8 17 30 92	3 28 2 30 16 58
3 13 14 0 31 63	3 21 9 58 0 92	3 28 4 12 51 58
3 13 14 1 0 57	3 21 11 39 20 59	3 28 5 54 15 59
3 14 10 40 20 88	3 21 11 39 23 57	3 28 5 54 18 57
3 14 10 40 23 88	3 22 3 7 20 59	3 29 0 43 15 59
3 14 12 13 0 93	3 22 3 7 24 62	3 29 0 43 18 58
3 14 12 14 20 93	3 22 4 47 20 92	3 29 0 43 21 62
3 14 12 21 0 93	3 22 6 29 10 92	3 29 2 24 17 58
3 14 13 54 20 59	3 22 8 10 10 92	3 29 5 48 15 59
3 14 13 55 10 63	3 22 9 52 21 59	3 31 0 31 21 59
3 14 13 55 30 58	3 22 9 53 15 57	3 31 5 35 15 59
3 14 14 2 3 62	3 23 3 1 20 59	4 1 3 48 15 59
3 15 8 54 2 59	3 23 3 1 21 92	4 1 22 38 15 59
3 15 8 54 4 58	3 23 3 1 26 62	4 2 3 42 15 59
3 15 12 10 1 62	3 23 4 41 20 92	4 2 22 32 15 59
3 16 12 2 41 58	3 23 6 24 0 92	4 3 3 36 15 59
3 16 12 9 16 62	3 23 8 5 10 92	4 3 22 26 15 59
3 17 5 18 13 59	3 23 9 46 10 59	4 3 22 26 18 57
3 17 5 18 15 58	3 23 9 46 13 57	4 4 20 41 20 59
3 17 8 33 30 59	3 24 2 54 20 59	4 4 20 42 20 57
3 17 8 33 33 62	3 24 2 54 23 58	4 5 20 34 25 59
3 18 5 5 30 59	3 24 2 54 25 62	4 5 20 34 28 57
3 18 5 5 31 92	3 24 4 35 22 58	4 6 20 28 30 59
3 18 6 45 30 59	3 24 6 19 3 58	4 6 20 28 33 57
3 18 6 45 31 92	3 24 7 59 12 58	4 7 20 22 30 59
3 18 6 45 34 62	3 24 9 40 10 59	4 7 20 22 33 57
3 18 8 27 30 92	3 24 9 40 13 57	4 8 18 36 30 59
3 18 10 9 20 92	3 25 2 48 15 59	4 8 18 36 33 57
3 18 11 48 45 57	3 25 2 48 18 58	4 9 18 29 30 59
	3 25 2 48 20 62	4 9 18 29 33 57
	3 25 4 29 16 58	4 10 18 16 30 59
	3 25 6 12 40 58	4 10 18 16 33 57

4 10	23 28 50	59	5 29	18 35 40	88	6 14	11 50 41	57
4 15	16 11 30	59	5 29	20 13 30	86	6 14	17 0 42	63
4 15	21 15 50	59	5 29	20 17 0	88	6 15	11 42 10	63
4 16	14 25 30	59	5 29	20 22 50	86	6 15	11 42 11	57
4 16	21 9 50	59	5 29	20 24 21	63	6 15	11 43 7	93
4 17	14 18 50	59	5 29	23 37 35	57	6 15	16 55 0	63
4 17	21 3 50	59	5 29	23 37 39	63	6 16	10 5 13	93
4 18	14 11 20	59	5 30	1 18 35	57	6 16	10 5 16	63
4 18	20 57 20	59	5 30	1 18 39	63	6 16	10 5 17	57
5 1	14 26 1	57	5 30	18 28 0	57	6 16	16 47 39	63
5 1	14 26 56	57	5 30	18 28 1	63	6 19	14 43 10	93
5 1	14 34 56	59	5 31	16 3 15	57	6 19	14 43 13	63
5 1	14 35 6	59	5 31	18 21 45	88	6 19	14 43 14	57
5 1	16 8 0	63	5 31	18 22 30	86	6 24	12 36 45	63
5 1	16 8 1	57	5 31	20 3 45	88	6 24	14 8 30	57
5 1	16 9 20	63	5 31	20 10 0	86	6 24	14 9 49	63
5 1	16 9 21	57	6 1	18 15 35	63	6 30	8 38 31	93
5 2	12 45 35	63	6 1	18 15 36	93	6 30	8 38 34	63
5 2	12 45 38	88	6 1	18 15 37	63	6 30	8 38 35	57
5 2	12 45 42	86	6 1	18 15 38	93	6 30	10 17 59	63
5 2	12 48 30	88	6 1	18 15 41	63	7 4	2 47 28	57
5 2	14 20 30	63	6 1	18 21 50	57	7 6	2 47 29	57
5 2	14 20 33	88	6 1	18 22 47	63	7 25	16 11 51	63
5 2	14 20 47	86	6 1	18 22 48	93	7 25	16 11 52	88
5 2	14 23 30	88	6 1	18 22 53	63	7 25	16 19 20	86
5 2	14 30 0	86	6 8	14 10 52	93	7 25	16 20 12	93
5 3	16 9 20	63	6 8	14 10 55	63	7 25	16 20 16	63
5 4	10 51 23	63	6 8	14 10 56	57	7 25	16 20 17	57
5 4	10 51 25	88	6 8	19 13 20	63	8 3	13 34 40	88
5 4	10 51 28	86	6 8	19 22 0	57	8 3	13 41 30	86
5 4	10 51 40	88	6 8	19 22 26	63	8 3	16 58 5	88
5 4	12 27 30	86	6 9	14 5 57	93	8 3	17 4 3	86
5 4	12 27 30	57	6 9	14 6 0	63	8 3	17 4 44	63
5 4	12 28 48	63	6 9	14 6 1	57	8 5	11 46 50	57
5 4	14 8 0	57	6 9	19 16 20	63	8 5	11 47 15	63
5 4	14 8 50	88	6 10	13 55 17	93	8 11	9 27 0	57
5 5	7 24 40	86	6 10	13 55 20	63	8 17	12 3 30	57
5 5	7 24 45	63	6 10	13 55 21	57	8 17	12 5 50	88
5 5	7 24 50	88	6 10	19 0 31	63	8 17	12 12 15	86
5 5	9 4 30	86	6 11	12 17 41	93	8 17	12 12 40	63
5 5	9 4 40	57	6 11	12 17 44	63	8 17	10 31 30	63
5 5	9 5 4	63	6 11	12 17 45	57	8 23	1 17 0	57
5 5	9 5 9	63	6 11	18 54 36	63	8 23	1 17 43	63
5 5	9 5 24	93	6 12	12 10 52	93	9 2	22 25 0	57
5 5	9 5 29	93	6 12	12 10 55	63	9 2	22 25 20	63
5 5	9 5 34	88	6 12	12 10 56	57	9 14	21 5 40	88
5 5	9 5 39	88	6 12	18 55 22	63	9 14	21 14 20	86
5 5	10 40 10	86	6 13	12 4 21	93	9 14	21 14 45	93
5 5	10 41 15	93	6 13	12 4 24	63	9 14	21 45 30	63
5 5	10 41 20	93	6 13	12 4 25	57	9 14	21 47 30	63
5 5	10 41 25	88	6 13	17 7 54	63	9 15	17 37 0	93
5 5	12 20 30	86	6 14	11 50 34	83	9 15	17 37 6	63
5 5	12 21 0	63	6 14	11 50 37	93	9 20	18 45 45	59
5 9	10 15 0	57	6 14	11 50 40	63	9 25	14 52 30	59

9 27	11 14 0	59	12 19	15 57 0	57
9 30	12 29 50	59	12 19	15 57 22	63
10 1	12 22 50	59	12 19	13 39 10	63
10 2	12 22 50	59	1 14 ⁶⁸	5 24 0	88
10 3	12 23 50	57	1 14	5 24 10	86
10 4	10 39 10	63	1 14	5 25 0	93
10 4	12 17 30	57	1 14	5 26 0	93
10 4	12 18 25	63	1 14	5 26 30	63
10 5	12 10 10	57	1 14	5 27 0	93
10 5	12 10 57	63	1 14	5 28 30	63
10 10	9 56 0	93	1 14	7 42 0	88
10 10	9 56 15	63	2 5	17 6 10	63
10 11	9 43 30	93	3 1	17 41 40	88
10 11	13 39 10	63	3 2	3 7 0	86
10 14	23 15 0	93	3 14	21 7 30	93
10 15	0 55 0	63	3 14	21 9 0	88
10 26	21 46 0	57	3 14	21 9 30	86
10 26	21 47 30	63	3 14	22 44 0	93
10 26	21 54 0	57	3 14	22 45 5	93
10 26	21 54 0	63	3 14	22 46 35	93
10 26	21 55 10	57	3 15	2 7 0	88
10 26	21 55 10	63	3 15	20 25 0	86
10 26	21 56 28	57	3 15	21 59 0	93
10 26	21 56 28	63	3 15	23 40 0	93
11 2	14 22 30	57	3 16	1 23 0	93
11 2	17 45 36	63			
11 3	15 48 0	57			
11 3	15 49 42	63			
11 3	15 56 30	57			
11 3	15 56 54	63			
11 7	11 59 40	57			
11 7	15 23 24	63			
11 7	15 30 10	57			
11 7	15 31 4	63			
11 8	11 52 45	93			
11 8	15 14 0	63			
11 9	15 7 30	63			
11 9	11 45 30	93			
11 11	9 51 30	57			
11 18	14 5 49	63			
11 18	14 14 15	57			
11 18	14 14 52	63			
12 4	22 38 30	93			
12 4	22 38 33	63			
12 4	22 39 19	57			
12 8	22 12 45	63			
12 8	22 19 0	57			
12 8	22 19 35	63			
12 8	23 52 30	93			
12 8	23 52 36	63			
12 11	20 8 51	93			
12 11	20 8 51	63			
12 19	15 50 0	57			
12 19	15 50 45	63			

TIME OF SIGNIFICANT ACTIVITY

- OP16 -

ORBIT	DATE	UT TIME	ION CHAMBER	Scan mode, λ , or step			FLARE POSITION
				DOUBLE	SINGLE	GRATING	
179	3-20-67	1158	D35	1	1	1	S22W18
201	3-22	0034	D177	1	1	1	N25E70
203	3-22	↓	C126	1	1	1	
204	3-22	↓	C55	1	1	1	
228	3-23	1932	C108	1	1	1	N26E31
251	3-25	0612	C47	2	2	2	
263	3-26	0103	C44	1	1	2	
265	3-26	0424	C92	1	1	2	
270	3-26	1650	C107	1	1	2	N28E07
278	3-27	0056	C38	1	1	2	
296	3-28	0554	C105	1	1	1	
302	3-28	1740	D31	1	1	1	N21W38
322	3-30	0025	C217	1	1	1	S25W41
325	3-30	0400	C78	1	1	1	
353	4-01	0122	C167	1	1	3	N27W75
354	4-01	0206	C84	1	1	3	N18W68
356	4-01	0528	D36	1	1	1	
370	4-02	0342	C59	1	1	1	
415	4-05	0327	Q5	1			
516	4-11	2112	D31	2	1	3	S23W71
797	4-30	1156	C32	1	1	304	
798	4-30	1307	B131	1	1	304	
883	5-06	0450	D50	78		304	
884	5-06	0908	B35	78		304	
972	5-12	0137	A70	78	1	304	
1004	5-14	1610	B65	78	1	3	
1047	5-16	1136	B105	78	1	3	
1072	5-18	1805	C105	78	1	3	
1076	5-19	1549	C80	78	1	3	
1092	5-20	0139	B201	78	1	304	
1093	5-20	66	B196	78	1	304	
1100	5-20	1432	C53	78	1	304	
1121	5-22	1926	C122	78	1	304	
1122	5-22	0117	C38	78	1	304	
1123	5-22	0346	B115	78	1	304	
1147	5-23	1842	D255	78	1	1	
1173	5-25	1052	D30		1		
1183	5-26	0206	C55	78	1	304	
1215	5-28	0543	D235	78	1	2	
1227	5-29	0840	B89	78	1	2	
1344	6-05	1940	C39	78	229	335	
1463	6-13	1526	Q5	180		2	

ORBIT	DATE	UT TIME	ION CHAMBER	DOUBLE	SINGLE	GRATING	FLARE POSITION
1477	6-14	2040	C39	73		3	
1491	6-15	1153	A103	59		3	
1505	6-16	1006	B119	80		3	
1536	6-18	1130	B61	2		335	
1537	6-18	1816	C90	2	180	335	
1887	7-11	0744	C48	72	1	3	
1965	7-16	2337	C123			3	
2052	7-22	1659	C43			304	
2084	7-24	8053	D46	72	1	304	
2093	7-25	1120	C65		1	304	N28E47
2095	7-25	1429	D49	72	1	304	N28E39
2097	7-25	1620	C154			304	N28E38
2111	7-26	1500	B154			304	
2112	7-26	1620	C73			304	
2113	7-26	1800	C101			304	N13E28
2114	7-26	1950	B213			304	
2203	8-01	1740	D38		1	C	N27W80
2246	8-04	1226	C35			335	N31W90
2247	8-04	1411	C44			335	N20E70
2367	8-13	1615	B121			2	
2450	8-18	0233	D111	75		2	
2451	8-18	0400	C60			2	
2452	8-18	0600	C65			2	
2462	8-18	2137	C104	75	279	2	N24E93
2467	8-19	0420	C149			2	
2468	8-19	0655	C58				
2527	8-23	0518	C115			335	
2539	8-24	0100	C35			2	N26E21
2569	8-26	0018	C128	75	161	304	S20W00
2573	8-26	0649	C37			304	S20W04
2584	8-27	0020	C31			304	
2616	8-29	0310	C82			335	S21W42
2627	8-29	1945	C197			335	N28W51
2632	8-30	0500	C135			304	
2660	9-01	0200	C108			304	
2687	9-02	2040	C118			2	N26E22
3120	10-01	1240	C30	78		304	
3132	10-02	0800	C41			304	N15W34
3204	10-07	0405	C58			1	
3488	10-25	2327	C159			335	
3490	10-26	0210	C37			335	
3549	10-29	2316	D129			1	
3705	11-10	1508	C46			1	

ORBIT	DATE	UT TIME	ION CHAMBER	DOUBLE	SINGLE	GRATING	FLARE POSITION
3754	11-12	1313	C58		/	/	
3812	11-16	0922	C85		/		
3826	11-17	0817	C165		/	/	
4034	12-01	0236					
4213	12-13	1820	C90				
4269	12-16	1619	C159	/		/	
4270	12-16	1800	C43	/		/	
4271	12-16	1940	C163	/		/	
4284	12-17	1612	C115	/		/	
4288	12-18	1450	C69			/	
4300	12-18	1744	C51	/		/	
4389	12-24	0725	C44			/	
4391	12-24	1844	C245	/		/	
4568	1-05-68	0458	C162	/		/	
4683	1-13	0409	C59	/			

OSO-3 DATA - FORMAT FOR EXPERIMENTER #23 DATA TAPES

I. Introduction

The OSO-3 experimenter data tapes were originally produced by the Information Processing Division in 7-track, 800 BPI format. For Experiment #23 (Dr. Neupert, GSFC) the data was reformatted and written on 9-track, 1600 BPI tapes. Doing so saved tape storage space (two 7-track could be combined into one high-density 9-track tape), and the new format made data analysis in the IBM 360 computers somewhat easier.

A Goddard document exists which describes the (general) format of the original 7-track tapes, and of the associated Aspect Data tapes.* This note is intended to describe, as fully as possible, the format of the 9-track version of the experimenter tapes.

II. OSO-3 Telemetry Format

OSO-3 experiment data is transcribed in a 640 msec readout cycle consisting of 32 data words - this is called a main frame of data. There is also digital, wheel and sail subcommutator data read in a 48-frame cycle; i.e., one word of each, repeated every 48th main frame. For Exp. #23 the data words included on the tape are the following (Each "word" is 8 bits in length):

Main Frame Words:

Words 3 & 4 - Grating spectrometer, 1st readout. (This instrument is sampled twice in the readout cycle, i.e., every 320 msec:) (GRI)

Word 7 - Data housekeeping word (HSK)

* Data Processing Plan for Orbiting Solar Observatory (OSO-E). By G. B. Shearer and John H. Schmidt (Information Processing Division); August 1966 (GSFC).

Word 12 - Double spectrometer-Scintillator (DS1)
Word 14 - Double spectrometer - Proportional Counter (DS2)
Words 19 & 20- Grating spec., 2nd readout (GR2)
Word 24 - Single spectrometer (SSP)
Word 29 - Ion chamber (ION)

Wheel Subcom Data:

Wheel Word 29 - Day/Night Indicator (W29).

Sail Subcom Data:

Sail Words 4, 5, 6 & 7 (temperature data) (S4, S5, S6, S7)

III. OSO-3 Exp. Data Tape Format

Data from 96 main frames is grouped together into one logical record. Six logical records are combined into one physical record or block. The IBM System/360 data control block is:

DCB = (DEN=3, RECFM=VBS, LRECL=920, BLKSIZE=5524).

These are multifile tapes, with a double file mark after the last file of data. However, in certain cases (where a pass was unprocessable) there may be double file marks after other data files within the tapes (Refer to the "Table of Contents" listings).

Certain information (Words 1-4) is the same on each record of a data file, having been taken from the "header" record of the original 7-track tape.

Below is a description of each item in the record. Most items are either integer half-words (16 bits) or a single byte (8 bits) in length. Under "Type", the symbols mean:

L*1 - 8-bit item

I*2 - Half-word (16-bit) integer

I*4 - Full word (32-bit) integer

R*4 - 32-bit floating point

Word	Name	Type	
1	NFILE	I*2	- File no. on input tape (1, 2,...,)
	BLKNO	I*2	- Block (physical record) no.
2	NREC	I*2	- Record no. (1, 2...,6) within block
	STAND	I*2	- Ground station no.
3	SATNO	I*2	- Satellite no.
	(Spare)	I*2	- (Not used)
4	RTFP	R*4	- Real-time frame period (Time between main frames, about 320 msec.
5	FTI	I*2	- Flag time indicator
	DDI	I*2	- Dummy data indicator
6	NSYN1	I*2	- Total # of sync errors for the 96 frames.
	NSYN2	I*2	- # of sync errors in frames having more than one error each.
7	DAY	I*2	- Day of year
	NFGL	I*2	- # of groups of frames lost (between this and the next record)
8	ITOD	I*4	- Time of day (msec)
9	W29(1-2)	I*2	- Wheel subcom Word 29 (2 readings)
10	S4(1-2)	I*2)	- Sail subcom words (temperature readings) (sampled twice).
		)	
11	S5(1-2)	I*2)	
		)	
12	S6(1-2)	I*2)	
		)	
13	S7(1-2)	I*2)	

Word	Name	Type	
14-61	GR1(1-96)	I*2	)
			)
62-85	HSK(1-96)	L*1	)
			)
86-109	DS1(1-96)	L*1	)
			) - Main Frame Data Words
110-133	DS2(1-96)	L*1	)
			)
134-181	GR2(1-96)	I*2	)
			)
182-205	SSP(1-96)	L*1	)
			)
206-229	ION(1-96)	L*1	)

IV. Data Word Formats

Most of what follows is described in Attachment A, to which frequent references will be made.

1. Housekeeping Data

The housekeeping word (HSK) is used to indicate the subframe code status, ion chamber range, and overflow conditions affecting the crystal spectrometers (cf. Attachment A, pp. 10-13).

2. Grating Spectrometer

Two successive main frame words are combined to give a single 16-bit grating instrument readout; the first word (Word 3 or Word 19) contains the high-order bits. Note the proper time order of the data points: GR1(1) - Frame 1, Words 3-4

GR2(1) - Frame 1, Words 19-20

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GR1(96) - Frame 96, Words 3-4

GR2(96) - Frame 96, Words 19-20.

The two highest-order bits are used to signal when the instrument has completed a spectral scan and is changing direction (A, pp. 1-2, 8-9).

3. Crystal Spectrometers (SSP, DS1, DS2)

- a) Overflow (A, pp. 11-13) - When a reading requiring more than eight bits occurs, data words from two successive frames are put together to form a 14-bit accumulator (2 bits are used to indicate end of spectral scan), and the appropriate overflow bit is set in the housekeeping (HSK) word.

When overflow occurs, the low-order eight bits are read out in the current frame and the proper overflow bit is set in the next housekeeping word (i.e., HSK of the next frame).

When the overflow circuitry works properly, the next high-order six bits are read in the corresponding data word of the next frame. This is true, however, only for the single spectrometer: if V_1 and V_2 denote the two successive SSP readouts (leaving out the upper 2 bits of V_2),

$$\text{True Count} = V_1 + 256 * V_2$$

For the double spectrometer instruments the situation is a little more complicated, due to a problem in the telemetry logic. Again using V_1 and V_2 as the two readings, the situation can be diagrammed as follows:

V_2 even:

$$V_1 < 160: \text{count} = V_1 + 128 * V_2$$

$$V_1 \geq 160: \text{count} = V_1 + 128 * (V_2 - 2)$$

V₂ odd:

$$V_1 < 64: \text{count} = V_1 + 128 * (V_2 + 1)$$

$$V_1 \geq 64: \text{count} = V_1 + 128 * (V_2 - 1)$$

Note also that the proportional counter (DS2) failed to operate properly, and measures background radiation rather than the 2.5 - 6.4 Å it was intended to measure.

b) End-of-Spectral Scan Condition (A, p.8)

When a crystal spectrometer completes a spectral scan, the overflow conditions is triggered; in the 16-bit register thus formed, the two highest-order bits (i.e., two highest bits of the second 8-bit word) are used to signal the directional change.

4. Ion Chamber

The ion chamber readout can be in any one of the four amplification ranges indicated by the range indicator bits of the housekeeping word (A, p. 13). A linear conversion-counts to flux units can be used, the conversion factors being determined by the scale. Letting X=ion chamber count, we have flux = $K_1 + M_1 X$, (10^{-5} erg cm⁻² s⁻¹)

where K_1 and M_1 are given below:

i	Scale	Bit Code	K_1	M
1	A	111	-0.0945	0.0189
2	B	001	-1.025	0.215
3	C	010	-7.15	1.95
4	D	100	-118.0	21.8

V. Data Quality Indicators

Referring to the above table describing the record format, the following indicators have to do with data quality (Refer to the "Data Processing Plan" publication by Shearer and Schmidt, pp. 37-38).

1. FTI - Flag Time Indicator

If this contains a zero value, the entire 96 frames of the record consist of "dummy" data (i.e., "fill" data, or all 1's for each data word). This can happen when data is missing for short periods of time.

2. DDI - Dummy Data Indicator

If non-zero, indicates some frames of the record contain dummy data.

3. Sync Error Indicators (NSYN1, NSYN2)

These counters give some indication of data quality: if both are zero, no sync errors in the record. If NSYN2 is non-zero (multiple sync errors in some frames), the entire record should be considered doubtful data.

4. NFGL (No. of records lost)

This indicates when a gap occurs in the data following the current record.

ATTACHMENT A

SOLAR SPECTROMETER OSO-57 CHECKOUT

1.1 The experiment consists of four basic instruments; a crystal spectrometer measuring soft x-rays in the region of 1 to 2.5 Angstroms; a crystal spectrometer measuring soft x-rays in the region of 2.5 to 6.4 Angstroms; and the crystal spectrometer measuring soft x-rays in the region of 6.4 to 25 Angstroms; a grazing incidence grating spectrometer measuring soft x-rays in the region of 25 to 400 Angstroms. In addition to these four instruments, there is also incorporated in the experiment two ion chambers.

Each instrument is designed to respond to a set of pre-determined programs under the control of the ground command.

The grating spectrometer program is as follows: 25-400 Angstroms, three modes of operation.

Mode 1 will consist of a travel from 400-25 Angstroms at one step per 0.01 seconds, except for the travel of the six segment areas consisting of 64 steps where the speed will be one step at 0.32 seconds.

The retrace in this mode will consist of a maximum speed scan that is 0.01 seconds per step. In this mode, the instrument reverses travel and returns to the long wavelength end immediately after scanning the sixth segment.

Mode 2 will consist of a trace and retrace, each having a period of 16.384 minutes, where the speed will be two steps every 0.32 seconds.

Mode 3 will consist of a slow scan from 25-400 Angstroms at one step per 0.32 seconds in 32.768 minutes and a retrace at one step per 0.01 seconds, except for the travel of six segment areas consisting of 64 steps each where the speed will be one step per 0.32 seconds, as in Mode 1.

Data readout is inhibited during the fast scans (0.01 seconds per step).

Total number of steps for the grating spectrometer will be 6,144, approximately.

The double spectrometer program is as follows: 1 to 2.5 Angstroms and 2.5 to 6.4 Angstroms. Three modes of operation:

Mode 1 will consist of a scan in 2.73 minutes and a retrace in the same time, where the speed will be one step every 0.64 seconds.

Mode 2 will consist of a scan in 16.38 minutes and a retrace in the same time, where the speed will be one step every 3.84 seconds.

Mode 3 will consist of a scan in 32.76 minutes and a retrace in the same time, where the speed will be one step every 7.68 seconds.

The total number of steps will be 256 approximately.

The single spectrometer program is as follows: 6.4 to 25 Angstroms; two modes of operation.

Mode 1 will consist of a trace in 5.46 minutes and a retrace in the same time, where the speed will be one step every 0.64 seconds.

Mode 2 will consist of a scan in 21.84 minutes and a retrace in the same time, where the speed will be one step every 2.56 seconds.

The total number of steps will be 512 approximately.

1.2 The input circuit characteristics are:

Command	1	3.3 K. ohms
Command	2	3.3 K. ohms
Command	3	3.3 K. ohms
Command	4	700 ohms

Command	5	700	ohms
Command	6	3.3 K.	ohms
Command	7	5	K. ohms
Command	8	5	K. ohms
Command	9	5	K. ohms
Command	10	5	K. ohms
Command	11	5	K. ohms
Command	12	3.3 K.	ohms
Command	13	1	K. ohms
Command	14	1	K. ohms
Command	15	1	K. ohms
Command	16	5	K. ohms

1.7 A procedure has been devised to determine when the grating spectrometer is sighted on the sun by observing the maximum reflection from the zero image light trap. It is recommended that this be done on the polar table at Boulder and, at that time, the eye blocks be afixed finally to the instrument so as to line up the sun with the instrument fixed in this position.

2.1 There is no second level commutation of the data words. The first level commutation of the allocated data words is as follows:

Word 3/4	25 to 400 Angstrom range data
Word 7	Housekeeping data
Word 12	1 to 2.5 Angstrom range data
Word 14	2.5 to 6.5 Angstrom range data
Word 19/20	25 to 400 Angstrom range data
Word 24	6.5 to 25 Angstrom range data
Word 29	Ion chamber data

2.2 Four analog channels are utilized. All of these are furnished with temperature probe outputs, three being from Ball Brothers temperature probes located in various positions in the instrument and the fourth is located in the ion chamber electronics package. This latter probe does not derive its supply from the 15 volts regulated power furnished from the satellite.

Rear temperature probe	Analog readout #2
Center temperature probe	Analog readout #3
Forward temperature probe	Analog readout #4
Ion chamber electronics temperature probe	Analog readout #1

2.3 The following sub-division of data words applies:

INSTRUMENT TRAVEL LIMIT INDICATION

Provision is made to telemeter out a coding indication whenever one of the instruments activates a microswitch at either end of its travel.

For the double and single spectrometers, the closing of either the forward or reverse microswitch forces the accumulator into the overflow 14-bit code conditions. Simultaneously, a two-bit code is generated, indicating the state of the reversing relay in the spectrometer command memory. This two-bit code is then introduced into the 15th and 16th bit positions of the second transmitted word. This two-phase operation is described later. Under normal operation when the 14-bit overflow accumulator is being utilized, these bits appear as zeros. Thus an indication of the spectrometer drive direction and microswitch actuation is generated. It should be noted that in this instance, if no overflow of the 8-bit accumulator had occurred throughout the data acquisition cycle, the output

of the amplifiers is inhibited for one frame anyway, and the second frame will carry a word in which the bits from 9 through 14 are all zeros.

The grating spectrometer utilizes a somewhat different system for this indication, since the full capacity of 16 bits for the double word is utilized for data readout. Closure of either the forward or reverse microswitch which at the end of the next readout gate causes an inhibit signal to prevent further counting and allows a pair of "nors" to introduce a two-bit code, indicating the motor drive direction in the two most significant positions of the double word. When the subsequent word readout occurs, this code will be readout into the telemetry and the circuit reset for normal operation.

The following examples will serve to clarify these operations:

EXAMPLE

Double or Single Spectrometer

1. In case of no overflow:

1 1 0 1 1 1 1 0

Normal readout--8 bits

2. In case of overflow:

1st. word gate 1 1 1 0 1 1 1 1

2nd. word gate 0 0 0 1 0 0 0 0

Overflow readout--16 bits
No microswitch operation

When the microswitch is energized, the counters will "readout" as follows:

In case of no overflow

1st. word gate 1 1 0 1 1 1 1 0

2nd. word gate (microswitch is energized)

Forward microswitch

1 0 0 1 0 0 0 0

Reverse microswitch

0 1 0 1 0 0 0 0

In case of overflow, the "readout" will be the same as above, but some number will be indicated in the 9 through 14 digits, i.e., the first six digits of the second word.

Grating Spectrometer

The grating spectrometer accumulator "readout" for microswitch position would be:

Forward	1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Reverse	0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0

which will follow immediately after the "readout" of the last counter reading.

Note that the most significant digit is readout of each half-word first; the above examples show most significant digit conventionally on the left.

The single spectrometer occupies word 24; the double spectrometer occupies words 12 and 14.

HOUSEKEEPING DATA

The word allocated for housekeeping data is word 7. The eight bits of this word are sub-divided into three groups or sub-words. The first sub-word consists of two bits which are allocated to the indication of the sub-frame state. The particular scale of twelve codes was carefully selected. The maximum number of indications that can be derived from a two-bit code, is, of course four; so the utility is maximized by indicating every even frame and putting out a common code for odd frames over a sequence of six cycles. This indication at least can then be easily interpreted by the ground staff. Examining the indications given for three consecutive frames (i.e., one on either side of the desired frame) will

determine the frame sequence of any frame. Although a somewhat sparse indication, this should suffice when examining the data. The two-bit code is achieved by utilizing the (X) and the ($\bar{Y}$) output as indicated in the table below for the even frames; a zero output is provided for odd frames.

<u>Sub-Frame</u>	<u>W X Y Z</u>	<u>Binary Number Equivalent</u>	<u>Word 7</u>	
			<u>(X) Bit 1</u>	<u>(Y) Bit 2</u>
12/0	0 0 0 0	0	0	1
1	1 0 0 0	1	0	0 odd
2	0 1 0 0	2	1	1
3	1 1 0 0	3	0	0 odd
4	0 1 1 0	6	1	0
5	1 1 1 0	7	0	0 odd
6	0 0 0 1	8	0	1
7	1 0 0 1	9	0	0 odd
8	0 1 0 1	10	1	1
9	1 1 0 1	11	0	0 odd
10	0 1 1 1	14	1	0
11	1 1 1 1	15	0	0 odd

The next sub-word consisting of three bits, known as the Alpha word, is dedicated to the indication of the overflow condition of the single and double spectrometer accumulators. Only 8 bits are available for each of the spectrometers in the range 1 to 2.5, 2.5 to 6.5 and 6.5 to 25 Angstroms. An 8-bit word every 640 milliseconds is capable of recording only 400 counts per second. It is anticipated that under certain conditions, frequent saturation will occur and much valuable information lost.

The readout of these accumulators is then handled in the following manner. As long as the word does not exceed eight bits, these are read out as normal 8-bit words and should be interpreted as such. When the word exceeds eight bits, a further six-bit counter comes into operation. This effectively extends the capacity to fourteen bits. In the next word gate time after an overflow has occurred, the least significant eight bits are readout most significant digit first, in the usual manner, no indication being given. At this time, further counting is inhibited and the count stored. At the next word-7 time, overflow indication will appear as described below. This indicates that the remainder of the appropriate word is to be readout in that frame, i.e., the next six most significant bits of the fourteen-bit word are readout and these bits, together with the bits readout in the previous frame, comprise the fourteen-bit word and should be reduced as such. In order to readout eight complete bits at this time, the two most significant bits are always zero, unless a microswitch has been operated when these bits will be utilized as described above. Briefly, the presence of a "1" in one bit of the sub-word indicates an overflow condition, and the presence of an "0" indicates no overflow. The following indication applies for the sub-word:

1 0 0	Overflow data in word 14
0 1 0	Overflow data in word 12
0 0 1	Overflow data in word 24

Should overflow data occur in more than one of these words, the code is then used in combination; for example, 1 0 1 indicates an overflow data in both words 14 and 24.

The final sub-word consists of the three most significant digits in word 7. They are allocated to indicate the range of the ion chamber amplifier. The amplifier has four ranges and the indications received from this device are on one of four lines. These are applied to an encoding network and appear in the following manner:

<u>Range</u>	<u>Code</u>
1	1 1 1
2	0 0 1
3	0 1 0
4	1 0 0

It should be noted that the use of all zeros as a code has been obviated, so a failure in the indicating logic will not be mis-read as information.

	WORD 7			
0 0	0	0	0	0 0 0
	14	12	24	
Sub-Frame Code	Accumulator Overflow			Ion Chamber Range

OSO-3 DATA - FORMAT FOR EXPERIMENTER #23 DATA TAPES

I. Introduction

The OSO-3 experimenter data tapes were originally produced by the Information Processing Division in 7-track, 800 BPI format. For Experiment #23 (Dr. Neupert, GSFC) the data was reformatted and written on 9-track, 1600 BPI tapes. Doing so saved tape storage space (two 7-track could be combined into one high-density 9-track tape), and the new format made data analysis in the IBM 360 computers somewhat easier.

A Goddard document exists which describes the (general) format of the original 7-track tapes, and of the associated Aspect Data tapes.* This note is intended to describe, as fully as possible, the format of the 9-track version of the experimenter tapes.

II. OSO-3 Telemetry Format

OSO-3 experiment data is transcribed in a 640 msec readout cycle consisting of 32 data words - this is called a main frame of data. There is also digital, wheel and sail subcommutator data read in a 48-frame cycle; i.e., one word of each, repeated every 48th main frame. For Exp. #23 the data words included on the tape are the following (Each "word" is 8 bits in length):

Main Frame Words:

Words 3 & 4 - Grating spectrometer, 1st readout. (This instrument is sampled twice in the readout cycle, i.e., every 320 msec:) (GR1)

Word 7 - Data housekeeping word (HSK)

* Data Processing Plan for Orbiting Solar Observatory (OSO-E). By G. B. Shearer and John H. Schmidt (Information Processing Division); August 1966 (GSFC).

Word 12, - Double spectrometer-Scintillator (DS1)
Word 14 - Double spectrometer - Proportional Counter (DS2)
Words 19 & 20- Grating spec., 2nd readout (GR2)
Word 24 - Single spectrometer (SSP)
Word 29 - Ion chamber (ION)

Wheel Subcom Data:

Wheel Word 29 - Day/Night Indicator (W29).

Sail Subcom Data:

Sail Words 4, 5, 6 & 7 (temperature data) (S4, S5, S6, S7)

III. OSO-3 Exp. Data Tape Format

Data from 96 main frames is grouped together into one logical record. Six logical records are combined into one physical record or block. The IBM System/360 data control block is:

DCB = (DEN=3, RECFM=VBS, LRECL=920, BLKSIZE=5524).

These are multifile tapes, with a double file mark after the last file of data. However, in certain cases (where a pass was unprocessable) there may be double file marks after other data files within the tapes (Refer to the "Table of Contents" listings).

Certain information (Words 1-4) is the same on each record of a data file, having been taken from the "header" record of the original 7-track tape.

Below is a description of each item in the record. Most items are either integer half-words (16 bits) or a single byte (8 bits) in length. Under "Type", the symbols mean:

L*1 - 8-bit item

I*2 - Half-word (16-bit) integer

I*4 - Full word (32-bit) integer

R*4 - 32-bit floating point

Word	Name	Type	
1	NFILE	I*2	- File no. on input tape (1, 2,...,)
	BLKNO	I*2	- Block (physical record) no.
2	NREC	I*2	- Record no. (1, 2...,6) within block
	STAND	I*2	- Ground station no.
3	SATNO	I*2	- Satellite no.
	(Spare)	I*2	- (Not used)
4	RTFP	R*4	- Real-time frame period (Time between main frames, about 320 msec.
5	FTI	I*2	- Flag time indicator
	DDI	I*2	- Dummy data indicator
6	NSYN1	I*2	- Total # of sync errors for the 96 frames.
	NSYN2	I*2	- # of sync errors in frames having more than one error each.
7	DAY	I*2	- Day of year
	NFGL	I*2	- # of groups of frames lost (between this and the next record)
8	ITOD	I*4	- Time of day (msec)
9	W29(1-2)	I*2	- Wheel subcom Word 29 (2 readings)
10	S4(1-2)	I*2	) - Sail subcom words (temperature readings) (sampled twice).
11	S5(1-2)	I*2	
12	S6(1-2)	I*2	
13	S7(1-2)	I*2	

Word	Name	Type	
14-61	GR1(1-96)	I*2	)
			)
62-85	HSK(1-96)	L*1	)
			)
86-109	DS1(1-96)	L*1	)
			) - Main Frame Data Words
110-133	DS2(1-96)	L*1	)
			)
134-181	GR2(1-96)	I*2	)
			)
182-205	SSP(1-96)	L*1	)
			)
206-229	ION(1-96)	L*1	)

IV. Data Word Formats

Most of what follows is described in Attachment A, to which frequent references will be made.

1. Housekeeping Data

The housekeeping word (HSK) is used to indicate the subframe code status, ion chamber range, and overflow conditions affecting the crystal spectrometers (cf. Attachment A, pp. 10-13).

2. Grating Spectrometer

Two successive main frame words are combined to give a single 16-bit grating instrument readout; the first word (Word 3 or Word 19) contains the high-order bits. Note the proper time order of the data points: GR1(1) - Frame 1, Words 3-4

GR2(1) - Frame 1, Words 19-20

·
·
·
·

GR1(96) - Frame 96, Words 3-4

GR2(96) - Frame 96, Words 19-20.

The two highest-order bits are used to signal when the instrument has completed a spectral scan and is changing direction (A, pp. 1-2, 8-9).

3. Crystal Spectrometers (SSP, DS1, DS2)

- a) Overflow (A, pp. 11-13) - When a reading requiring more than eight bits occurs, data words from two successive frames are put together to form a 14-bit accumulator (2 bits are used to indicate end of spectral scan), and the appropriate overflow bit is set in the housekeeping (HSK) word.

When overflow occurs, the low-order eight bits are read out in the current frame and the proper overflow bit is set in the next housekeeping word (i.e., HSK of the next frame).

When the overflow circuitry works properly, the next high-order six bits are read in the corresponding data word of the next frame. This is true, however, only for the single spectrometer: if V_1 and V_2 denote the two successive SSP readouts (leaving out the upper 2 bits of V_2),

$$\text{True Count} = V_1 + 256 * V_2$$

For the double spectrometer instruments the situation is a little more complicated, due to a problem in the telemetry logic. Again using V_1 and V_2 as the two readings, the situation can be diagrammed as follows:

V_2 even:

$$V_1 < 160: \text{count} = V_1 + 128 * V_2$$

$$V_1 \geq 160: \text{count} = V_1 + 128 * (V_2 - 2)$$

V_2 odd:

$$V_1 < 64: \text{count} = V_1 + 128 * (V_2 + 1)$$

$$V_1 \geq 64: \text{count} = V_1 + 128 * (V_2 - 1)$$

Note also that the proportional counter (DS2) failed to operate properly, and measures background radiation rather than the 2.5 - 6.4 Å it was intended to measure.

b) End-of-Spectral Scan Condition (A, p.8)

When a crystal spectrometer completes a spectral scan, the overflow conditions is triggered; in the 16-bit register thus formed, the two highest-order bits (i.e., two highest bits of the second 8-bit word) are used to signal the directional change.

4. Ion Chamber

The ion chamber readout can be in any one of the four amplification ranges indicated by the range indicator bits of the housekeeping word (A, p. 13). A linear conversion-counts to flux units can be used, the conversion factors being determined by the scale. Letting X =ion chamber count, we have $\text{flux} = K_1 + M_1 X$, ($10^{-5} \text{ erg cm}^{-2} \text{ s}^{-1}$)

where K_1 and M_1 are given below:

i	Scale	Bit Code	K_1	M
1	A	111	-0.0945	0.0189
2	B	001	-1.025	0.215
3	C	010	-7.15	1.95
4	D	100	-118.0	21.8

V. Data Quality Indicators

Referring to the above table describing the record format, the following indicators have to do with data quality (Refer to the "Data Processing Plan" publication by Shearer and Schmidt, pp. 37-38).

1. FTI - Flag Time Indicator

If this contains a zero value, the entire 96 frames of the record consist of "dummy" data (i.e., "fill" data, or all 1's for each data word). This can happen when data is missing for short periods of time.

2. DDI - Dummy Data Indicator

If non-zero, indicates some frames of the record contain dummy data.

3. Sync Error Indicators (NSYN1, NSYN2)

These counters give some indication of data quality: if both are zero, no sync errors in the record. If NSYN2 is non-zero (multiple sync errors in some frames), the entire record should be considered doubtful data.

4. NFGL (No. of records lost)

This indicates when a gap occurs in the data following the current record.

67-020A-05A

Decommutation Program

The decommutation process produces experimenter tapes from the edit tapes. The basic output is one data record for each experimenter from each 96-frame edit record. The experimenter may request almost any arrangement of both experimenter data and necessary subcommutated data from that 96-frame edit record. In most cases, more than one of these experimenter records are written without the usual intervening gaps, thus producing longer tape records and achieving higher tape utilization. *times six for experiment 23.*

Since the unit of importance is a file and not a tape, summary labels will not be written on experimenter tapes. Each reel of tape mailed to the experimenter will be labeled with the following information: satellite name, experimenter's name, decommutation run number, experimenter's tape-sequence number from this run, and the number. *and # of files?*

Analysis Program for the Goddard Experimenter

In addition to the data processing discussed throughout the remainder of this document, data from the GSFC experiment will be analyzed using programs written under the supervision of the OSO data processing engineer. *John Johnson* This program will provide the experimenter with a display of the data acquired by his experiment in such a manner that his study of the data and final conclusions may be accomplished readily.

Attitude-Determination Program

In order that attitude information be as accurate as possible, the initial computations will be delayed for at least one month after launch. This will permit an accumulation of a large sample of magnetometer data to be used in the attitude computation. Since the hour-by-hour variations in the spin-axis orientation solution error are large and range from a couple of degrees to no solution at all when the sun vector and the local magnetic field vector are nearly parallel, the roll-angle will be based upon a highly weighted curve which essentially excludes all data where the probable error in the observation exceeds 2 degrees. The computed attitude will be merged with an orbit tape (orb 3A) yielding a tape consisting of a tape label, orbit label, and aspect (attitude-orbit) data records. The contents of the OSO attitude-orbit tape are given in Tables 6, 7, and 8. The attitude-orbit tapes (like the data tapes) will be binary and either high or low density as requested by experimenters.

Table 5

Aspect Tape Label Format

Word	Description	Units
1	Satellite identification	
2	Year	
3	Beginning time of first orbit on this tape	Day count
4	Beginning time of first orbit on this tape	Milliseconds of day
5	End time of last orbit on this tape	Day count
6	End time of last orbit on this tape	Milliseconds of day
7	Number of records/tape	
8	First orbit number	
9	Last orbit number	
10-520	Unassigned	

(All data are represented in IBM-7094 floating point form.)

Table 6

Aspect Orbital Identification Records

Word	Description	Units
1	Orbit number (pass no.)	
2	Orbit start time	Day count
3	Orbit start time	Milliseconds of day
4	Orbit end time	Day count
5	Orbit end time	Milliseconds of day
6	Sampling rate	Milliseconds
7	Satellite ID	
8	Year	

Table 6 (continued)

Word	Description	Units
9	Eclipse start time (present)	Day count
10	Eclipse start time (orbit)	Milliseconds of day
11	Eclipse end time (present)	Day count
12	Eclipse end time (orbit)	Milliseconds of day
13	Eclipse start time (next)	Day count
14	Eclipse start time (orbit)	Milliseconds of day
15	Eclipse end time (next)	Day count
16	Eclipse end time (orbit)	Milliseconds of day
17	Date	Radians
18	Day count of year	
19	Apparent sidereal time	
20-30	Some of these are used for harmonics	
31	Date (epoch)	Kilometers
32	Day count of year (epoch)	
33	Seconds of day (epoch)	
34	Semi-major axis	
35	Eccentricity	Degrees
36	Inclination	
37	Right ascension of ascending node	Degrees
38	Rate of change of right ascension of ascending node	Degrees/day
39	Argument of perigee	Degrees
40	Rate of change of argument of perigee	Degrees/day
41	Period	Minutes
42	Rate of change of period	Minutes/day
43	Minimum roll error	Radians
44	Time of minimum roll error	Day count
45	Time of minimum roll error	Milliseconds of day
46	Roll-axis orientation	X-component
47	Roll-axis orientation	Y-component
48	Roll-axis orientation	Z-component
49	Right ascension of roll-axis	Degrees
50	Declination of roll-axis	Degrees

Table 6 (continued)

Word	Description	Units
51	Pitch-axis orientation	X-component
52	Pitch-axis orientation	Y-component
53	Pitch-axis orientation	Z-component
54	Right ascension of pitch-axis	Degrees
55	Declination of pitch-axis	Degrees
56	Yaw/spin-axis orientation	X-component
57	Yaw/spin-axis orientation	Y-component
58	Yaw/spin-axis orientation	Z-component
59	Right ascension of yaw/spin-axis	Degrees
60	Declination of yaw/spin-axis	Degrees
61-520	Unassigned	

(All data are represented in IBM-7094 floating point form.)

Table 7

Aspect Data Record

36 bit

Word	Description	Units
1	Time	Day count
2	Time	Milliseconds of day
3	Satellite position vector	X-component (km)
4	Satellite position vector	Y-component (km)
5	Satellite position vector	Z-component (km)
6	Right ascension of satellite position vector	Degrees
7	Declination of satellite position vector	Degrees
8	Velocity vector	X-component (km/sec)
9	Velocity vector	Y-component (km/sec)
10	Velocity vector	Z-component (km/sec)
11	Right ascension of velocity vector	Degrees
12	Declination of velocity vector	Degrees

over minute only

Table 7 (continued)

Word	Description	Units
13	Geodetic latitude	Degrees
14	Geodetic longitude	Degrees
15	Geodetic altitude	Kilometers
16	Unit solar vector	X-component
17	Unit solar vector	Y-component
18	Unit solar vector	Z-component
19	Right ascension of unit solar vector	Degrees
20	Declination of unit solar vector	Degrees
21	McIlwain's "L" parameter	Earth radii
22	Magnetic field strength	Gamma
23	Unit magnetic vector	X-component
24	Unit magnetic vector	Y-component
25	Unit magnetic vector	Z-component
26	Right ascension of magnetic vector	Degrees
27	Declination of magnetic vector	Degrees
28	Pitch angle	Radians
29	Roll angle: Smoothed value using roll angles with less than 2° roll angle error	Radians
30	Aspect angle (between roll axis and aspect reference axis)	Radians
31	Time increment (Δt) since digital subcommutator word number one	Milliseconds
32	Roll-axis orientation	X-component
33	Roll-axis orientation	Y-component
34	Roll-axis orientation	Z-component
35	Right ascension of roll-axis	Degrees
36	Declination of roll-axis	Degrees
37	Pitch-axis orientation	X-component
38	Pitch-axis orientation	Y-component
39	Pitch-axis orientation	Z-component
40	Right ascension of pitch-axis	Degrees
41	Declination of pitch-axis	Degrees

53 5th min
54 million
55 End day
56 million
57 Pass it
58 Day in night
Lorenzo

Table 7 (continued)

Word	Description	Units
42	Yaw/spin-axis orientation	X-component
43	Yaw/spin-axis orientation	Y-component
44	Yaw/spin-axis orientation	Z-component
45	Right ascension of yaw/spin-axis	Degrees
46	Declination of yaw/spin-axis	Degrees
47	Aspect reference—axis orientation	X-component
48	Aspect reference—axis orientation	Y-component
49	Aspect reference—axis orientation	Z-component
50	Right ascension of aspect reference—axis	Degrees
51	Declination of aspect reference—axis	Degrees
52	Spin rate	Rev/sec.
53-65	Unassigned	
66-520	Seven additional 65-word items	
*	End of record flag (*will appear in first word after last item with data.)	-666.666

Total of 8 min/record

(All data are represented in IBM-7094 floating point form.)

Command Record

Punched cards and/or listings of commands which were recorded on the analog tape will be provided to the experimenters. Each command and the time of the execution pulse will be included.

FUNCTIONS OF THE QUALITY CONTROL GROUP

The Quality Control Group shall have the responsibility of assuring that the tapes produced for the experimenters by the Information Processing Division contain the proper information. To do this, Quality Control must check and approve the edit tapes before they are decommutated as well as check the output of the decommutation run. The duties of Quality Control are:

- Quality Control and Edit Program Output Check—To verify that the files processed were in chronological order without any skips other than file rejections listed in the summary list.

