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LANDSAT MULTISPECTRAL SCANNER-X (MSS-X) DATA FORMAT CONTROL BOOK (DFCB)

Version 5.0

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USGS
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LANDSAT MULTISPECTRAL SCANNER-X (MSS-X)
DATA FORMAT CONTROL BOOK (DFCB)

September 2013

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Executive Summary

The Landsat Project uses a series of satellites to gather Earth resource data. The main goal of the Project is data continuity. Landsat's Global Survey Mission is to repeatedly capture images of the Earth's land mass, coastal boundaries, and coral reefs; and to ensure that the data acquired support the scientific goals of observing changes in the Earth's land surface and surrounding environment.

The U.S. Geological Survey (USGS) and the National Aeronautics and Space Administration (NASA) support the Landsat Project. NASA developed and launched the spacecraft. USGS handles the flight operations, maintenance, and management of all ground data reception, processing, archiving, product generation, and distribution.

This Data Format Control Book (DFCB) defines the content and layout of the Landsat Multispectral Scanner-X (MSS-X) format. This DFCB defines the detailed formats of the output files the MSS-X Archive Conversion System (MACS) generates and the Landsat Archive Manager (LAM) archives.

Document History

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Contents

List of Figures

Section 1 Introduction

This Data Format Control Book (DFCB) defines the detailed formats and contents of the output files (image, calibration, header, and color-composite browse files) the Multispectral Scanner-X (MSS-X) Archive Conversion System (MACS) generates. MACS makes these files available for the Landsat Archive Manager (LAM) to archive. The file formats contained in this DFCB are applicable to the interface between the MACS and the LAM.

This document contains information for the MSS-X file type. This DFCB describes the purpose of the file type and contains the following subsections:

- Data Format Overview — describes the general contents of the data type and how the data are logically arranged.
- File-Naming Convention — contains the naming convention of the files.
- Data Format Definition — describes each type of file in explicit technical detail.

Section 2 MSS-X

2.1 Data Format Overview

The MSS-X format is a legacy format created when 9-Track Multispectral Scanner (MSS) Computer Compatible Tape-X (CCT-X) tapes Band-interleaved by Pixel Pair (BIP-2) were converted to newer media with an easier-to-use format. The Wideband Video Tape Conversion System (WVTCS) was developed to allow processing of legacy Landsat 1, 2, and 3 MSS data from antiquated 28-track video tapes to high-density Digital Linear Tape (DLT). WVTCS-generated files matched the MSS-X format.

MACS is a system based on the legacy WVTCS with updates to run on the current architecture, correct legacy data problems, process data declared 'orphan' by WVTCS (MSS-X data for which no metadata existed), and interface with the current Earth Resources Observation and Science (EROS) Center systems. MACS ingests the WVTCS-generated raw data files (currently stored in the EROS archive) and converts the files to the MSS-X format.

With the ongoing efforts of the Landsat Global Archive Consolidation (LGAC) Project to recover legacy Landsat data from all missions, and the recent efforts to revive the Landsat 5 MSS sensor, capabilities were needed to process these data. MACS ingests raw wideband MSS data for Landsat 1-5 and converts the data to the MSS-X format.

2.2 MSS-X File-Naming Convention

The MSS-X file-naming convention for non-browse files is as follows:

SPPPRRRFFYYDDDMNZB

where

Parameter Description	Filename Position	Values
Satellite Number	S	1 = Landsat 1 2 = Landsat 2 3 = Landsat 3 4 = Landsat 4 5 = Landsat 5
WRS Path	PPP	001-251 (Landsat 1,2,3) 001-233 (Landsat 4,5)
WRS Row	RRR	001-248
Fixed	FF	Always 00
Year	YY	Two-digit year appropriate for the mission
Day Of Year	DDD	001-366
Mode	M	Always 9
Mux	N	Always 0
File Identifier	Z	h = Header File 1-4 = Band identifier for image data files c = Calibration Data File s = Scan Data File
Band Identifier	B	Band identifier of the calibration file **Note**: This field is only applicable for calibration file names.

Figure 2-1. File-Naming Convention

The MSS-X file-naming convention for a browse file is as follows:

SPPPRRRFFYYDDDMNVV.jpg

where

Parameter Description	Filename Position	Values
Satellite Number	S	1 = Landsat 1 2 = Landsat 2 3 = Landsat 3 4 = Landsat 4 5 = Landsat 5
WRS Path	PPP	001-251 (Landsat 1,2,3) 001-233 (Landsat 4,5)
WRS Row	RRR	001-248
Fixed	FF	Always 00
Year	YY	Two-digit year appropriate for the mission
Day Of Year	DDD	001-366
Mode	M	Always 9
Mux	N	Always 0
Version Number	VV	File version number
File Extension	.jpg	File name extension

Figure 2-2. Browse File-Naming Convention

2.2.1 Example MSS-X File Names

Examples of the MSS-X files naming convention include the following:

12490300074292901
12490300074292902
12490300074292903
12490300074292904
1249030007429290h
1249030007429290s
1249030007429290c1
1249030007429290c2
1249030007429290c3
1249030007429290c4
124903000742929001.jpg

The file names represent a scene associated with Landsat 1, Path 249, Row 30, acquired on October 19, 1974.

Note: The physical band numbers range from 1 to 4, which represent MSS Bands 4 to 7 for Landsat 1-3 and MSS Bands 1 to 4 for Landsat 4-5.

2.3 Data Format Definition

The MACS-generated output files contain a header, image, calibration, and browse file for each identified scene. The files are grouped together by naming convention, but each group has the same layout and format.

2.3.1 Header Data File

The MSS-X Header File contains information about the image, including sun angles, sun elevation, scene center, nadir, tick marks, and calibration modifiers. Each header file contains one 6156 byte record. During the Wideband Video Tape conversion, this information was extracted or derived from data in the Daily Image Annotation Tape (DIAT) or Spacecraft Location and Attitude Tape (SLAT) files. For scenes where there was no DIAT or SLAT information (i.e., WVTCS orphans or raw wideband data), an independent routine generated the data. This routine generates a satellite model using North American Air Defense (NORAD) Two Line Element (TLE) ephemeris data to identify the scene center times and other scene-related metadata used to populate the header file.

The following pages describe the format and contents of the MSS-X Header File. All fields in the MSS-X Header File are stored in American Standard Code for Information Interchange (ASCII). The “I” and “F” notations in the “Format” column indicate the type of data described (“A” = ASCII, “I” = integer, “F” = float); the notations are similar to a Fortran format specification for printing the data.

Notes: MSS-X Header Files may contain blanks when the value is unknown or are applicable only to the original CCT-X archive data.

Many of the fields in the MSS-X Header File are followed by a blank separator. These cases are documented as follows: the “Fields” column includes two field numbers, the “Format” column includes two format notations, and the “Description” column includes the notation “Blank separator” as a second description following the field description.

MSS-X Header Record Description:

Field	Bytes	Format	Description
1	1-11	A11	"SCENE ID = "
2	12-23	A12	Old Scene ID can be in one of two formats 'edddd-hhmmsb' format, where e = Encoded Project Identifier: 1 = Landsat 1, 2 = Landsat 2, 3 = Landsat 3 dddd = Day number relative to launch at time of observation hh = Hour at time of observation mm = Minute at time of observation s = Tens of seconds at time of observation (truncated) b = NDPF Identification Code: RBV: 1,2,3 MSS: 4,5,6,7,8 n = Sequential subframe ID orphan-xxxx where xxxx = vald, prob, poss. or susp. Each specifies a level of confidence in the scene framing used to generate the orphan data records.
3	24-40	A17	" RECORD LENGTH = "
4	41-44	I4	Length of video data record on original CCT-X tape, in bytes

5	45-59	A15	" MSS DATA MODE:" Data modes as listed below.
6	60-75	A16	" SUN CAL DATA = "
7	76	I1	1 if sun calibration data available, 0 if it is not available
8	77-89	A13	" CAL WEDGE = "
9	90	I1	1 if calibration wedge available, 0 if it is not available
10	91-103	A13	" COMP DATA = "
11	104	I1	1 for compressed data, 0 for linear, 2 for unknown
12	105-121	A17	" HI GAIN BND 1 = "
13	122	I1	1 for high gain on first band, 0 for low gain, 2 for unknown
14	123-139	A17	" HI GAIN BND 2 = "
15	140	I1	1 for high gain on second band, 0 for low gain, 2 for unknown
16	141-157	A17	" DECOMPRESSION = "
17	158	I1	1 if decompression performed, 0 if it is not
18	159-173	A15	" CALIBRATION = "
19	174	I1	Calibration applied using M&A constants (fields 68-331) 0 = no, 1 = yes, 2 = no calibration applied
20	175-196	A22	" LINE LENGTH ADJUST = "
21	197	I1	1 if line length has been adjusted, 0 if it is not adjusted
22	198-221	A24	" ADJUSTED LINE LENGTH = "
23	222-225	I4	MSS adjusted line length, in bytes
24	226-242	A17	" CREATION DATE = "
25	243-252	A10	Date of creation in 'mm dd yyyy' or 'mm-dd-yyyy' format, where mm = two-digit month dd = two-digit day of month yyyy = four-digit year
26	253-268	A16	" SIAT VERSION = "
27	269	I1	Original SIAT version number. The format version number of the SIAT records on the original Computer Compatible Tape (CCT). Possible version numbers include 1, 2, 3, and 4. This value is zero if no SIAT file exists.
28	270-286	A17	" EXPOSURE DATE = "
29	287-295	A09	Date of exposure in 'dd mmm yy' format, where dd = day of month mmm = three-character abbreviation of name of month yy = last two digits of year
30	296-314	A19	" CENTER LAT/LONG = "
31	315-328	A14	Center lat/lon in 'add-mm/addd-mm', where a = direction: N, S, E, W dd and ddd = degrees mm = minutes
32	329-350	A22	" ORBIT DIR PATH-ROW = "
33	351-358	A08	Orbit direction, path-row in 'appp-rrr' format where a = D, descending or A, ascending ppp = path rrr = row
34	359-376	A18	" NADIR LAT/LONG = "
35	377-390	A14	Nadir Lat/lon in 'add-mm/addd-mm' format as defined in field 31
36	391-422	A32	" SENSOR SPECTRAL BAND ID CODE = "
37	423-427	A05	Sensor Spectral Band Identification Code where M4567 - Landsat 1-3 M1234 - Landsat 4-5 Blank if unknown M indicates MSS and the digits indicate the presence of the corresponding spectral band. Historically, this field was rarely used and was usually left blank.
38	428-443	A16	" SUN ELEVATION ="

39	444-446	I3	Sun elevation angle at the midpoint of the MSS frame, specified to the nearest degree
40	447-461	A15	" SUN AZIMUTH = "
41	462-466	A5	Sun azimuth angle from true North at the midpoint of the MSS frame, specified to the nearest degree, in 'Annn ', 'A-nnn', 'AZnnn' format where nnn = degrees, -nnn = negative degrees
42	467-480	A14	" CORRECTION = "
43	481	A01	Correction applied, where 'U' = Uncorrected 'S' = System Level Correction applied 'G' = Geometrically corrected based on geometric GCPs 'R' = Geometrically corrected based on relative GCPs
44	482-490	A09	" SCALE = "
45	491	A01	Scale of the image, where '1' = 185km x 185km (~100nm x 100nm) '2' = 92.5km x 92.5km (~50nm x 50nm)
46	492-505	A14	" PROJECTION = "
47	506	A01	Projection code, where 'L' = Lambert 'P' = Polar Stereo 'S' = Space Oblique Mercator 'U' = UTM ' ' = Not applicable (uncorrected image), or unknown
48	507-531	A25	" CENTER EPHEMERIS DATA = "
49	532	A01	Type of ephemeris data used to compute the image center, where 'P' = Predictive 'D' = Definitive
50	533-551	A19	" SENSOR GAIN OPT = "
51	552	A01	Sensor gain options, where 'H' = High gain 'L' = Low gain
52	553-572	A20	" MSS TRANSMISSION = "
53	573	A01	Type of MSS transmission, where '1' = Linear mode '2' = Compressed mode
54	574-592	A19	" LANDSAT MISSION = "
55	593	A01	Landsat mission where '1' = Landsat 1 '2' = Landsat 2 '3' = Landsat 3 '4' = Landsat 4 '5' = Landsat 5
56	594-607	A14	" DAY NUMBER = "
57	608-611	I4	Day number relative to launch at time of observation
58	612-619	A08	" HOUR = "
59	620-621	I2	Hours at time of observation
60	622-631	A10	" MINUTE = "
61	632-633	I2	Minutes at time of observation
62	634-643	A10	" SECOND = "
63	644	I1	Tens of seconds at time of observation
64	645-656	A12	" MSS DATA = "
65	657	A01	Type of MSS data, where 'D' = Direct 'R' = Recorded
66	658-677	A20	" ACQUISITION SITE = "
67	678	A01	MSS data acquisition site, where 'A' = Alaska 'N' = NASA/Goddard 'B' = Brazil 'R' = Sweden

'C'	= Canada	'T'	= Argentina
'G'	= Goldstone	'U'	= Australia
'J'	= Japan	'X', 'Y', 'Z'	= Mobile
'L'	= Chile		

68	679-713	A35	" BAND 4 LOW GAIN/COMP MULT CONST = "	
69,70	714-731	F17.8, 1X	Sensor 1 multiplicative constant,	Blank separator
71,72	732-749	F17.8, 1X	Sensor 2 multiplicative constant,	Blank separator
73,74	750-767	F17.8, 1X	Sensor 3 multiplicative constant,	Blank separator
75,76	768-785	F17.8, 1X	Sensor 4 multiplicative constant,	Blank separator
77,78	786-803	F17.8, 1X	Sensor 5 multiplicative constant,	Blank separator
79	804-820	F17.8	Sensor 6 multiplicative constant	
80	821-854	A34	" BAND 4 LOW GAIN/COMP ADD CONST = "	
81,82	855-872	F17.8, 1X	Sensor 1 additive constant,	Blank separator
83,84	873-890	F17.8, 1X	Sensor 2 additive constant,	Blank separator
85,86	891-908	F17.8, 1X	Sensor 3 additive constant,	Blank separator
87,88	909-926	F17.8, 1X	Sensor 4 additive constant,	Blank separator
89,90	927-944	F17.8, 1X	Sensor 5 additive constant,	Blank separator
91	945-961	F17.8	Sensor 6 additive constant	
92	962-998	A37	" BAND 4 LOW GAIN/LINEAR MULT CONST = "	
93,94	999-1016	F17.8, 1X	Sensor 1 multiplicative constant,	Blank separator
95,96	1017-1034	F17.8, 1X	Sensor 2 multiplicative constant,	Blank separator
97,98	1035-1052	F17.8, 1X	Sensor 3 multiplicative constant,	Blank separator
99,100	1053-1070	F17.8, 1X	Sensor 4 multiplicative constant,	Blank separator
101,102	1071-1088	F17.8, 1X	Sensor 5 multiplicative constant,	Blank separator
103	1089-1105	F17.8	Sensor 6 multiplicative constant	
104	1106-1141	A36	" BAND 4 LOW GAIN/LINEAR ADD CONST = "	
105,106	1142-1159	F17.8, 1X	Sensor 1 additive constant,	Blank separator
107,108	1160-1177	F17.8, 1X	Sensor 2 additive constant,	Blank separator
109,110	1178-1195	F17.8, 1X	Sensor 3 additive constant,	Blank separator
111,112	1196-1213	F17.8, 1X	Sensor 4 additive constant,	Blank separator
113,114	1214-1231	F17.8, 1X	Sensor 5 additive constant,	Blank separator
115	1232-1248	F17.8	Sensor 6 additive constant	
116	1249-1284	A36	" BAND 4 HIGH GAIN/COMP MULT CONST = "	
117,118	1285-1302	F17.8, 1X	Sensor 1 multiplicative constant,	Blank separator
119,120	1303-1320	F17.8, 1X	Sensor 2 multiplicative constant,	Blank separator
121,122	1321-1338	F17.8, 1X	Sensor 3 multiplicative constant,	Blank separator
123,124	1339-1356	F17.8, 1X	Sensor 4 multiplicative constant,	Blank separator
125,126	1357-1374	F17.8, 1X	Sensor 5 multiplicative constant,	Blank separator
127	1375-1391	F17.8	Sensor 6 multiplicative constant	
128	1392-1426	A35	" BAND 4 HIGH GAIN/COMP ADD CONST = "	
129,130	1427-1444	F17.8, 1X	Sensor 1 additive constant,	Blank separator
131,132	1445-1462	F17.8, 1X	Sensor 2 additive constant,	Blank separator
133,134	1463-1480	F17.8, 1X	Sensor 3 additive constant,	Blank separator
135,136	1481-1498	F17.8, 1X	Sensor 4 additive constant,	Blank separator
137,138	1499-1516	F17.8, 1X	Sensor 5 additive constant,	Blank separator
139	1517-1533	F17.8	Sensor 6 additive constant	
140	1534-1571	A38	" BAND 4 HIGH GAIN/LINEAR MULT CONST = "	
141,142	1572-1589	F17.8. 1X	Sensor 1 multiplicative constant,	Blank separator
143,144	1590-1607	F17.8. 1X	Sensor 2 multiplicative constant,	Blank separator
145,146	1608-1625	F17.8. 1X	Sensor 3 multiplicative constant,	Blank separator
147,148	1626-1643	F17.8. 1X	Sensor 4 multiplicative constant,	Blank separator
149,150	1644-1661	F17.8. 1X	Sensor 5 multiplicative constant,	Blank separator
151	1662-1678	F17.8	Sensor 6 multiplicative constant	
152	1679-1715	A37	" BAND 4 HIGH GAIN/LINEAR ADD CONST = "	
153,154	1716-1733	F17.8. 1X	Sensor 1 additive constant,	Blank separator
155,156	1734-1751	F17.8. 1X	Sensor 2 additive constant,	Blank separator
157,158	1752-1769	F17.8. 1X	Sensor 3 additive constant,	Blank separator
159,160	1770-1787	F17.8. 1X	Sensor 4 additive constant,	Blank separator
161,162	1788-1805	F17.8. 1X	Sensor 5 additive constant,	Blank separator
163	1806-1822	F17.8	Sensor 6 additive constant	
164	1823-1857	A35	" BAND 5 LOW GAIN/COMP MULT CONST = "	

165,166	1858-1875	F17.8. 1X	Sensor 1 multiplicative constant,	Blank separator
167,168	1876-1893	F17.8. 1X	Sensor 2 multiplicative constant,	Blank separator
169,170	1894-1911	F17.8. 1X	Sensor 3 multiplicative constant,	Blank separator
171,172	1912-1929	F17.8. 1X	Sensor 4 multiplicative constant,	Blank separator
173,174	1930-1947	F17.8. 1X	Sensor 5 multiplicative constant,	Blank separator
175	1948-1964	F17.8	Sensor 6 multiplicative constant	
176	1965-1998	A34	" BAND 5 LOW GAIN/COMP ADD CONST = "	
177,178	1999-2016	F17.8. 1X	Sensor 1 additive constant,	Blank separator
179,180	2017-2034	F17.8. 1X	Sensor 2 additive constant,	Blank separator
181,182	2035-2052	F17.8. 1X	Sensor 3 additive constant,	Blank separator
183,184	2053-2070	F17.8. 1X	Sensor 4 additive constant,	Blank separator
185,186	2071-2088	F17.8. 1X	Sensor 5 additive constant,	Blank separator
187	2089-2105	F17.8	Sensor 6 additive constant	
188	2106-2142	A37	" BAND 5 LOW GAIN/LINEAR MULT CONST = "	
189,190	2143-2160	F17.8. 1X	Sensor 1 multiplicative constant,	Blank separator
191,192	2161-2178	F17.8. 1X	Sensor 2 multiplicative constant,	Blank separator
193,194	2179-2196	F17.8. 1X	Sensor 3 multiplicative constant,	Blank separator
195,196	2197-2214	F17.8. 1X	Sensor 4 multiplicative constant,	Blank separator
197,198	2215-2232	F17.8. 1X	Sensor 5 multiplicative constant,	Blank separator
199	2233-2249	F17.8	Sensor 6 multiplicative constant	
200	2250-2285	A36	" BAND 5 LOW GAIN/LINEAR ADD CONST = "	
201,202	2286-2303	F17.8. 1X	Sensor 1 additive constant,	Blank separator
203,204	2304-2321	F17.8. 1X	Sensor 2 additive constant,	Blank separator
205,206	2322-2339	F17.8. 1X	Sensor 3 additive constant,	Blank separator
207,208	2340-2357	F17.8. 1X	Sensor 4 additive constant,	Blank separator
209,210	2358-2375	F17.8. 1X	Sensor 5 additive constant,	Blank separator
211	2376-2392	F17.8	Sensor 6 additive constant	
212	2393-2428	A36	" BAND 5 HIGH GAIN/COMP MULT CONST = "	
213,214	2429-2446	F17.8. 1X	Sensor 1 multiplicative constant,	Blank separator
215,216	2447-2464	F17.8. 1X	Sensor 2 multiplicative constant,	Blank separator
217,218	2465-2482	F17.8. 1X	Sensor 3 multiplicative constant,	Blank separator
219,220	2483-2500	F17.8. 1X	Sensor 4 multiplicative constant,	Blank separator
221,222	2501-2518	F17.8. 1X	Sensor 5 multiplicative constant,	Blank separator
223	2519-2535	F17.8	Sensor 6 multiplicative constant	
224	2536-2570	A35	" BAND 5 HIGH GAIN/COMP ADD CONST = "	
225,226	2571-2588	F17.8. 1X	Sensor 1 additive constant,	Blank separator
227,228	2589-2606	F17.8. 1X	Sensor 2 additive constant,	Blank separator
229,230	2607-2624	F17.8. 1X	Sensor 3 additive constant,	Blank separator
231,232	2625-2642	F17.8. 1X	Sensor 4 additive constant,	Blank separator
233,234	2643-2660	F17.8. 1X	Sensor 5 additive constant,	Blank separator
235	2661-2677	F17.8	Sensor 6 additive constant	
236	2678-2715	A38	" BAND 5 HIGH GAIN/LINEAR MULT CONST = "	
237,238	2716-2733	F17.8. 1X	Sensor 1 multiplicative constant,	Blank separator
239,240	2734-2751	F17.8. 1X	Sensor 2 multiplicative constant,	Blank separator
241,242	2752-2769	F17.8. 1X	Sensor 3 multiplicative constant,	Blank separator
243,244	2770-2787	F17.8. 1X	Sensor 4 multiplicative constant,	Blank separator
245,246	2788-2805	F17.8. 1X	Sensor 5 multiplicative constant,	Blank separator
247	2806-2822	F17.8	Sensor 6 multiplicative constant	
248	2823-2859	A37	" BAND 5 HIGH GAIN/LINEAR ADD CONST = "	
249,250	2860-2877	F17.8. 1X	Sensor 1 additive constant,	Blank separator
251,252	2878-2895	F17.8. 1X	Sensor 2 additive constant,	Blank separator
253,254	2896-2913	F17.8. 1X	Sensor 3 additive constant,	Blank separator
255,256	2914-2931	F17.8. 1X	Sensor 4 additive constant,	Blank separator
257,258	2932-2949	F17.8. 1X	Sensor 5 additive constant,	Blank separator
259	2950-2966	F17.8	Sensor 6 additive constant	
260	2967-3001	A35	" BAND 6 LOW GAIN/COMP MULT CONST = "	
261,262	3002-3019	F17.8. 1X	Sensor 1 multiplicative constant,	Blank separator
263,264	3020-3037	F17.8. 1X	Sensor 2 multiplicative constant,	Blank separator
265,266	3038-3055	F17.8. 1X	Sensor 3 multiplicative constant,	Blank separator
267,268	3056-3073	F17.8. 1X	Sensor 4 multiplicative constant,	Blank separator
269,270	3074-3091	F17.8. 1X	Sensor 5 multiplicative constant,	Blank separator
271	3092-3108	F17.8	Sensor 6 multiplicative constant	

272	3109-3142	A34	" BAND 6 LOW GAIN/COMP ADD CONST = "
273,274	3143-3160	F17.8. 1X	Sensor 1 additive constant, Blank separator
275,276	3161-3178	F17.8. 1X	Sensor 2 additive constant, Blank separator
277,278	3179-3196	F17.8. 1X	Sensor 3 additive constant, Blank separator
279,280	3197-3214	F17.8. 1X	Sensor 4 additive constant, Blank separator
281,282	3215-3232	F17.8. 1X	Sensor 5 additive constant, Blank separator
283	3233-3249	F17.8	Sensor 6 additive constant
284	3250-3286	A37	" BAND 6 LOW GAIN/LINEAR MULT CONST = "
285,286	3287-3304	F17.8. 1X	Sensor 1 multiplicative constant, Blank separator
287,288	3305-3322	F17.8. 1X	Sensor 2 multiplicative constant, Blank separator
289,290	3323-3340	F17.8. 1X	Sensor 3 multiplicative constant, Blank separator
291,292	3341-3358	F17.8. 1X	Sensor 4 multiplicative constant, Blank separator
293,294	3359-3376	F17.8. 1X	Sensor 5 multiplicative constant, Blank separator
295	3377-3393	F17.8	Sensor 6 multiplicative constant
296	3394-3429	A36	" BAND 6 LOW GAIN/LINEAR ADD CONST = "
297,298	3430-3447	F17.8. 1X	Sensor 1 additive constant, Blank separator
299,300	3448-3465	F17.8. 1X	Sensor 2 additive constant, Blank separator
301,302	3466-3483	F17.8. 1X	Sensor 3 additive constant, Blank separator
303,304	3484-3501	F17.8. 1X	Sensor 4 additive constant, Blank separator
305,306	3502-3519	F17.8. 1X	Sensor 5 additive constant, Blank separator
307	3520-3536	F17.8	Sensor 6 additive constant
308	3537-3573	A37	" BAND 7 LOW GAIN/LINEAR MULT CONST = "
309,310	3574-3591	F17.8. 1X	Sensor 1 multiplicative constant, Blank separator
311,312	3592-3609	F17.8. 1X	Sensor 2 multiplicative constant, Blank separator
313,314	3610-3627	F17.8. 1X	Sensor 3 multiplicative constant, Blank separator
315,316	3628-3645	F17.8. 1X	Sensor 4 multiplicative constant, Blank separator
317,318	3646-3663	F17.8. 1X	Sensor 5 multiplicative constant, Blank separator
319	3664-3680	F17.8	Sensor 6 multiplicative constant
320	3681-3716	A36	" BAND 7 LOW GAIN/LINEAR ADD CONST = "
321,322	3717-3734	F17.8. 1X	Sensor 1 additive constant, Blank separator
323,324	3735-3752	F17.8. 1X	Sensor 2 additive constant, Blank separator
325,326	3753-3770	F17.8. 1X	Sensor 3 additive constant, Blank separator
327,328	3771-3788	F17.8. 1X	Sensor 4 additive constant, Blank separator
329,330	3789-3806	F17.8. 1X	Sensor 5 additive constant, Blank separator
331	3807-3823	F17.8	Sensor 6 additive constant
332	3824-3838	A15	" SENSOR GAIN = "
333,334	3839-3840	I1. 1X	MSS Sensor Gain, first band , Blank separator (0=low, 1=high, 2=unknown)
335	3841	I1	MSS Sensor Gain, second band (0=low, 1=high, 2=unknown)
336	3842-3860	A19	" SENSOR ENCODING = "
337,338	3861	I1. 1X	MSS Sensor Encoding, first band, Blank separator
339,340	3863	I1. 1X	MSS Sensor Encoding, second band, Blank separator
341	3865	I1	MSS Sensor Encoding, third band (Sensor encoding: 0=linear, 1=compressed, 2=unknown)
342	3866-3884	A19	" MSS SUN CAL DAY = "
343	3885-3889	A5	MSS Sun Cal Day in '0dddd' format
344	3890-3908	A19	" SUN CAL SENSORS = "
345,346	3909-3915	I6. 1X	MSS Sun Cal Sensor number 1, Blank separator
347,348	3916-3922	I6. 1X	MSS Sun Cal Sensor number 2, Blank separator
349,350	3923-3929	I6. 1X	MSS Sun Cal Sensor number 3, Blank separator
351,352	3930-3936	I6. 1X	MSS Sun Cal Sensor number 4, Blank separator

353,354	3937-3943	I6. 1X	MSS Sun Cal Sensor number 5,	Blank separator
355,356	3944-3950	I6. 1X	MSS Sun Cal Sensor number 6,	Blank separator
357,358	3951-3957	I6. 1X	MSS Sun Cal Sensor number 7,	Blank separator
359,360	3958-3964	I6. 1X	MSS Sun Cal Sensor number 8,	Blank separator
361,362	3965-3971	I6. 1X	MSS Sun Cal Sensor number 9,	Blank separator
363,364	3972-3978	I6. 1X	MSS Sun Cal Sensor number 10,	Blank separator
365,366	3979-3985	I6. 1X	MSS Sun Cal Sensor number 11,	Blank separator
367,368	3986-3992	I6. 1X	MSS Sun Cal Sensor number 12,	Blank separator
369,370	3993-3999	I6. 1X	MSS Sun Cal Sensor number 13,	Blank separator
371,372	4000-4006	I6. 1X	MSS Sun Cal Sensor number 14,	Blank separator
373,374	4007-4013	I6. 1X	MSS Sun Cal Sensor number 15,	Blank separator
375,376	4014-4020	I6. 1X	MSS Sun Cal Sensor number 16,	Blank separator
377,378	4021-4027	I6. 1X	MSS Sun Cal Sensor number 17,	Blank separator
379,380	4028-4034	I6. 1X	MSS Sun Cal Sensor number 18,	Blank separator
381,382	4035-4041	I6. 1X	MSS Sun Cal Sensor number 19,	Blank separator
383,384	4042-4048	I6. 1X	MSS Sun Cal Sensor number 20,	Blank separator
385,386	4049-4055	I6. 1X	MSS Sun Cal Sensor number 21,	Blank separator
387,388	4056-4062	I6. 1X	MSS Sun Cal Sensor number 22,	Blank separator
389,390	4063-4069	I6. 1X	MSS Sun Cal Sensor number 23,	Blank separator
391	4070-4075	I6	MSS Sun Cal Sensor number 24	

392	4076-4101	A26	" GMT OF EXP AT SCN CNTR = "
393	4102-4117	A16	Greenwich Mean Time of exposure at scene center in '0000ddddhhmmsscc' format, where 0000 = four zeros dddd = day of year (right-justified) hh = hour of day mm = minute of hour ss = second of minute cc = hundredths of second
394	4118-4142	A25	" SPACECRAFT TIME OF EX = "
395	4143-4158	A16	Spacecraft Time of exposure at scene center in '00ddddhhmmssmmm0' format, where 00 = two zeros dddd = days since launch (right-justified) hh = hour of day mm = minute of hour ss = second of minute mmm= milliseconds 0 = zero

396	4159-4183	A25	" NORMALIZED ALT CHANGE = "	
397,398	4184-4195	F11.8. 1X	Normalized Altitude Change at IC -13.80300,	Blank separator
399,400	4196-4207	F11.8. 1X	Normalized Altitude Change at IC -10.35225,	Blank separator
401,402	4208-4219	F11.8. 1X	Normalized Altitude Change at IC -6.90150,	Blank separator
403,404	4220-4231	F11.8. 1X	Normalized Altitude Change at IC -3.45075,	Blank separator
405,406	4232-4243	F11.8. 1X	Normalized Altitude Change at IC,	Blank separator
407,408	4244-4255	F11.8. 1X	Normalized Altitude Change at IC +3.45075,	Blank separator
409,410	4256-4267	F11.8. 1X	Normalized Altitude Change at IC +6.90150,	Blank separator
411,412	4268-4279	F11.8. 1X	Normalized Altitude Change at IC +10.35225,	Blank separator
413	4280-4290	F11.8	Normalized Altitude Change at IC +13.80300	
			(Normalized Altitude Change is: (Altitude – H) / H, where H is nominal altitude)	

414	4291-4309	A19	" ALTITUDE (N.M.) = "	
415,416	4310-4320	F10.6. 1X	Altitude (NM) at IC -13.80300,	Blank separator

417,418	4321-4331	F10.6. 1X	Altitude (NM) at IC -10.35225,	Blank separator
419,420	4332-4342	F10.6. 1X	Altitude (NM) at IC - 6.90150,	Blank separator
421,422	4343-4353	F10.6. 1X	Altitude (NM) at IC - 3.45075,	Blank separator
423,424	4354-4364	F10.6. 1X	Altitude (NM) at IC,	Blank separator
425,426	4365-4375	F10.6. 1X	Altitude (NM) at IC + 3.45075,	Blank separator
427,428	4376-4386	F10.6. 1X	Altitude (NM) at IC + 6.90150,	Blank separator
429,430	4387-4397	F10.6. 1X	Altitude (NM) at IC +10.35225,	Blank separator
431	4398-4407	F10.6	Altitude (NM) at IC +13.80300	
432	4408-4441	A34	" VEHICLE ROLL AT IMAGE CTR TIME = "	
433	4442-4450	F9.6	Vehicle Roll at ICT (radians)	
434	4451-4485	A35	" VEHICLE PITCH AT IMAGE CTR TIME = "	
435	4486-4494	F9.6	Vehicle Pitch at ICT (radians)	
436	4495-4527	A33	" VEHICLE YAW AT IMAGE CTR TIME = "	
437	4528-4536	F9.6	Vehicle Yaw at ICT (radians)	
438	4537-4551	A15	" ROLL VALUES = "	
439,440	4552-4561	F9.6. 1X	Roll value at IC - 13.80300 (radians), Blank separator	
441,442	4562-4571	F9.6. 1X	Roll value at IC - 10.35225 (radians), Blank separator	
443,444	4572-4581	F9.6. 1X	Roll value at IC - 6.90150 (radians), Blank separator	
445,446	4582-4591	F9.6. 1X	Roll value at IC - 3.45075 (radians), Blank separator	
447,448	4592-4601	F9.6. 1X	Roll value at IC, (radians), Blank separator	
449,450	4602-4611	F9.6. 1X	Roll value at IC + 3.45075 (radians), Blank separator	
451,452	4612-4621	F9.6. 1X	Roll value at IC + 6.90150 (radians), Blank separator	
453,454	4622-4631	F9.6. 1X	Roll value at IC +10.35225 (radians), Blank separator	
455	4632-4640	F9.6	Roll value at IC +13.80300 (radians)	
456	4641-4656	A16	" PITCH VALUES = "	
457,458	4657-4666	F9.6. 1X	Pitch value at IC -13.80300 (radians), Blank separator	
459,460	4667-4676	F9.6. 1X	Pitch value at IC -10.35225 (radians), Blank separator	
461,462	4677-4686	F9.6. 1X	Pitch value at IC - 6.90150 (radians), Blank separator	
463,464	4687-4696	F9.6. 1X	Pitch value at IC - 3.45075 (radians), Blank separator	
465,466	4697-4706	F9.6. 1X	Pitch value at IC (radians), Blank separator	
467,468	4707-4716	F9.6. 1X	Pitch value at IC +3.45075 (radians), Blank separator	
469,470	4717-4726	F9.6. 1X	Pitch value at IC +6.90150 (radians), Blank separator	
471,472	4727-4736	F9.6. 1X	Pitch value at IC +10.35225 (radians), Blank separator	
473	4737-4745	F9.6	Pitch value at IC +13.80300 (radians)	
474	4746-4759	A14	" YAW VALUES = "	
475,476	4760-4769	F9.6. 1X	Yaw value at IC -13.80300 (radians), Blank separator	
477,478	4770-4779	F9.6. 1X	Yaw value at IC -10.35225 (radians), Blank separator	
479,480	4780-4789	F9.6. 1X	Yaw value at IC - 6.90150 (radians), Blank separator	
481,482	4790-4799	F9.6. 1X	Yaw value at IC - 3.45075 (radians), Blank separator	
483,484	4800-4809	F9.6. 1X	Yaw value at IC (radians), Blank separator	
485,486	4810-4819	F9.6. 1X	Yaw value at IC + 3.45075 (radians), Blank separator	
487,488	4820-4829	F9.6. 1X	Yaw value at IC + 6.90150 (radians), Blank separator	
489,490	4830-4839	F9.6. 1X	Yaw value at IC +10.35225 (radians), Blank separator	
491	4840-4848	F9.6	Yaw value at IC +13.8030 (radians)	
492	4849-4862	A14	" IMAGE SKEW = "	
493	4863-4873	F11.8	Image Skew in radians	
494	4874-4903	A30	" NORMALIZED VELOCITY CHANGE = "	
495	4904-4914	F11.8	Normalized Velocity change ((velocity – V) / V)	
496	4915-4928	A14	" MEAN PITCH = "	
497	4929-4937	F9.6	Mean Pitch in radians	
498	4938-4950	A13	" MEAN ROLL = "	

499	4951-4959 F9.6	Mean Roll in radians	
500	4960-4971 A12	" MEAN YAW = "	
501	4972-4980 F9.6	Mean Yaw in radians	
502	4981-4999 A19	" MEAN PITCH RATE = "	
503	5000-5008 F9.6	Mean Pitch Rate in radians	
504	5009-5026 A18	" MEAN ROLL RATE = "	
505	5027-5035 F9.6	Mean Roll Rate in radians	
506	5036-5052 A17	" MEAN YAW RATE = "	
507	5053-5061 F9.6	Mean Yaw Rate in radians	
508	5062-5078 A17	" MEAN ALTITUDE = "	
509	5079-5085 I7	Mean Altitude in meters	
510	5086-5107 A22	" MEAN ALTITUDE RATE = "	
511	5108-5111 I4	Mean Altitude Rate in meters/second	
512	5112-5138 A27	" GMT MILLISECONDS OF DAY = "	
513,514	5139-5147 I8. 1X	GMT Milliseconds of Day at ICT - 25 seconds,	Blank separator
515,516	5148-5156 I8. 1X	GMT Milliseconds of Day at ICT - 20 seconds,	Blank separator
517,518	5157-5165 I8. 1X	GMT Milliseconds of Day at ICT - 15 seconds,	Blank separator
519,520	5166-5174 I8. 1X	GMT Milliseconds of Day at ICT - 10 seconds,	Blank separator
521,522	5175-5183 I8. 1X	GMT Milliseconds of Day at ICT - 5 seconds,	Blank separator
523,524	5184-5192 I8. 1X	GMT Milliseconds of Day at ICT,	Blank separator
525,526	5193-5201 I8. 1X	GMT Milliseconds of Day at ICT + 5 seconds,	Blank separator
527,528	5202-5210 I8. 1X	GMT Milliseconds of Day at ICT + 10 seconds,	Blank separator
529,530	5211-5219 I8. 1X	GMT Milliseconds of Day at ICT + 15 seconds,	Blank separator
531,532	5220-5228 I8. 1X	GMT Milliseconds of Day at ICT + 20 seconds,	Blank separator
533	5229-5236 I8	GMT Milliseconds of Day at ICT + 25 seconds	
534	5237-5254 A18	" NADIR LATITUDE = "	
535,536	5255-5264 F9.6. 1X	Nadir Latitude (radians) at ICT - 25 seconds	Blank separator
537,538	5265-5274 F9.6. 1X	Nadir Latitude (radians) at ICT - 20 seconds,	Blank separator
539,540	5275-5284 F9.6. 1X	Nadir Latitude (radians) at ICT - 15 seconds,	Blank separator
541,542	5285-5294 F9.6. 1X	Nadir Latitude (radians) at ICT - 10 seconds,	Blank separator
543,544	5295-5304 F9.6. 1X	Nadir Latitude (radians) at ICT - 5 seconds,	Blank separator
545,546	5305-5314 F9.6. 1X	Nadir Latitude (radians) at ICT ,	Blank separator
547,548	5315-5324 F9.6. 1X	Nadir Latitude (radians) at ICT + 5 seconds,	Blank separator
549,550	5325-5334 F9.6. 1X	Nadir Latitude (radians) at ICT + 10 seconds,	Blank separator
551,552	5335-5344 F9.6. 1X	Nadir Latitude (radians) at ICT + 15 seconds,	Blank separator
553,554	5345-5354 F9.6. 1X	Nadir Latitude (radians) at ICT + 20 seconds,	Blank separator
555	5355-5363 F9.6	Nadir Latitude (radians) at ICT + 25 seconds	
556	5364-5382 A19	" NADIR LONGITUDE = "	
557,558	5383-5392 F9.6. 1X	Nadir Longitude (radians) at ICT - 25 seconds,	Blank separator
559,560	5393-5402 F9.6. 1X	Nadir Longitude (radians) at ICT - 20 seconds,	Blank separator
561,562	5403-5412 F9.6. 1X	Nadir Longitude (radians) at ICT - 15 seconds,	Blank separator
563,564	5413-5422 F9.6. 1X	Nadir Longitude (radians) at ICT - 10 seconds,	Blank separator
565,566	5423-5432 F9.6. 1X	Nadir Longitude (radians) at ICT - 5 seconds,	Blank separator
567,568	5433-5442 F9.6. 1X	Nadir Longitude (radians) at ICT,	Blank separator
569,570	5443-5452 F9.6. 1X	Nadir Longitude (radians) at ICT + 5 seconds,	Blank separator
571,572	5453-5462 F9.6. 1X	Nadir Longitude (radians) at ICT +10 seconds,	Blank separator
573,574	5463-5472 F9.6. 1X	Nadir Longitude (radians) at ICT +15 seconds,	Blank separator
575,576	5473-5482 F9.6. 1X	Nadir Longitude (radians) at ICT +20 seconds,	Blank separator
577	5483-5491 F9.6	Nadir Longitude (radians) at ICT +25 seconds	
578	5492-5503 A12	" ALTITUDE = "	
579,580	5504-5511 I7. 1X	Altitude (meters) at ICT - 25 seconds,	Blank separator
581,582	5512-5519 I7. 1X	Altitude (meters) at ICT - 20 seconds,	Blank separator

583,584	5520-5527 I7. 1X	Altitude (meters) at ICT - 15 seconds,	Blank separator
585,586	5528-5535 I7. 1X	Altitude (meters) at ICT - 10 seconds,	Blank separator
587,588	5536-5543 I7. 1X	Altitude (meters) at ICT - 5 seconds,	Blank separator
589,590	5544-5551 I7. 1X	Altitude (meters) at ICT,	Blank separator
591,592	5552-5559 I7. 1X	Altitude (meters) at ICT + 5 seconds,	Blank separator
593,594	5560-5567 I7. 1X	Altitude (meters) at ICT +10 seconds,	Blank separator
595,596	5568-5575 I7. 1X	Altitude (meters) at ICT +15 seconds,	Blank separator
597,598	5576-5583 I7. 1X	Altitude (meters) at ICT +20 seconds,	Blank separator
599	5584-5590 I7	Altitude (meters) at ICT +25 seconds	
600	5591-5617 A27	" MSS TOP EDGE TICK MARKS = "	
601,602	5618-5627 F9.6. 1X	Top edge tick mark Position number 1,	Blank separator
603,604	5628-5636 A08, 1X	Top edge tick mark Annotation number 1,	Blank separator
605,606	5637-5646 F9.6. 1X	Top edge tick mark Position number 2,	Blank separator
607,608	5647-5655 A08, 1X	Top edge tick mark Annotation number 2,	Blank separator
609,610	5656-5665 F9.6. 1X	Top edge tick mark Position number 3,	Blank separator
611,612	5666-5674 A08, 1X	Top edge tick mark Annotation number 3,	Blank separator
613,614	5675-5684 F9.6. 1X	Top edge tick mark Position number 4,	Blank separator
615,616	5685-5693 A08, 1X	Top edge tick mark Annotation number 4,	Blank separator
617,618	5694-5703 F9.6. 1X	Top edge tick mark Position number 5,	Blank separator
619,620	5704-5712 A08, 1X	Top edge tick mark Annotation number 5,	Blank separator
621,622	5713-5722 F9.6. 1X	Top edge tick mark Position number 6,	Blank separator
623	5723-5730 A08	Top edge tick mark Annotation number 6	
624	5731-5758 A28	" MSS LEFT EDGE TICK MARKS = "	
625,626	5759-5768 F9.6. 1X	Left edge tick mark Position number 1,	Blank separator
627,628	5769-5777 A08, 1X	Left edge tick mark Annotation number 1,	Blank separator
629,630	5778-5787 F9.6. 1X	Left edge tick mark Position number 2,	Blank separator
631,632	5788-5796 A08, 1X	Left edge tick mark Annotation number 2,	Blank separator
633,634	5797-5806 F9.6. 1X	Left edge tick mark Position number 3,	Blank separator
635,636	5807-5815 A08, 1X	Left edge tick mark Annotation number 3,	Blank separator
639,640	5826-5834 A08, 1X	Left edge tick mark Annotation number 4,	Blank separator
641,642	5835-5844 F9.6. 1X	Left edge tick mark Position number 5,	Blank separator
643,644	5845-5853 A08, 1X	Left edge tick mark Annotation number 5,	Blank separator
645,646	5854-5863 F9.6. 1X	Left edge tick mark Position number 6,	Blank separator
647	5864-5871 A08	Left edge tick mark Annotation number 6	
648	5872-5900 A29	" MSS RIGHT EDGE TICK MARKS = "	
649	5901-5910 F9.6. 1X	Right edge tick mark Position number 1,	Blank separator
651	5911-5919 A08, 1X	Right edge tick mark Annotation number 1,	Blank separator
653	5920-5929 F9.6. 1X	Right edge tick mark Position number 2,	Blank separator
655	5930-5938 A08, 1X	Right edge tick mark Annotation number 2,	Blank separator
657	5939-5948 F9.6. 1X	Right edge tick mark Position number 3,	Blank separator
659	5949-5957 A08, 1X	Right edge tick mark Annotation number 3,	Blank separator
661	5958-5967 F9.6. 1X	Right edge tick mark Position number 4,	Blank separator
663	5968-5976 A08, 1X	Right edge tick mark Annotation number 4,	Blank separator
665	5977-5986 F9.6. 1X	Right edge tick mark Position number 5,	Blank separator
667	5987-5995 A08, 1X	Right edge tick mark Annotation number 5,	Blank separator
669	5996-6005 F9.6. 1X	Right edge tick mark Position number 6,	Blank separator
671	6006-6013 A08	Right edge tick mark Annotation number 6	
672	6014-6043 A30	" MSS BOTTOM EDGE TICK MARKS = "	
673	6044-6053 F9.6. 1X	Bottom edge tick mark Position number 1,	Blank separator
675	6054-6062 A08, 1X	Bottom edge tick mark Annotation number 1,	Blank separator
677	6063-6072 F9.6. 1X	Bottom edge tick mark Position number 2,	Blank separator
679	6073-6081 A08, 1X	Bottom edge tick mark Annotation number 2,	Blank separator
681	6082-6091 F9.6. 1X	Bottom edge tick mark Position number 3,	Blank separator
683	6092-6100 A08, 1X	Bottom edge tick mark Annotation number 3,	Blank separator

685	6101-6110 F9.6. 1X	Bottom edge tick mark Position number 4,	Blank separator
687	6111-6119 A08, 1X	Bottom edge tick mark Annotation number 4,	Blank separator
689	6120-6129 F9.6. 1X	Bottom edge tick mark Position number 5,	Blank separator
691	6130-6138 A08, 1X	Bottom edge tick mark Annotation number 5,	Blank separator
693	6139-6148 F9.6. 1X	Bottom edge tick mark Position number 6,	Blank separator
695	6149-6156 A08	Bottom edge tick mark Annotation number 6	

2.3.2 Image Data Files

The MSS-X image data are stored in the Band Sequential (BSQ) format. Each band is stored in a separate file. Each image file contains 2340 3600-byte records. The data for each band contain uncalibrated data. Also, decompression is not performed on the data.

2.3.2.1 Adjusted Line Length

In the original sensor data, the length of the scan lines in a scene could vary due to small variations in the period of the mirror. In the MSS-X image file, each scan line in a scene has the same length. The scan lines are adjusted to a standard length by the insertion of "synthetic" pixels at regular intervals, as indicated by “LINE LENGTH ADJUST = 1” in the header file. The NASA Data Processing Facility (NDPF) at the Goddard Space Flight Center (GSFC) originally used this method of line length adjustment in creating CCT-X tapes, as described in Appendix C of the “Generation and Physical Characteristics” documents listed in the References section. The same method of line length adjustment is used in MACS for the generation of MSS-X image files. MSS-X image records are nominally aligned by the insertion of registration fill characters at the beginning and/or the end of each line, as described in the "Transmission of Data" section of the "Generation and Physical Characteristics" documents listed in the References section. In addition, the records are null-padded at the end to fill a fixed-size 3600-byte record.

Band 4 Image Record Description:

Field	Bytes	Format	Description
1	1 - 6	B	6 Nulls: registration fill characters
2	7 - 24*n	I	Image data for Band 4, 1 byte per pixel
3	24*n - 3600	B	Null fill

Band 5 Image Record Description:

Field	Bytes	Format	Description
1	1 - 4	B	4 Nulls: registration fill characters
2	5 -24*n-2	I	Image data for Band 5, 1 byte per pixel
3	24*n-2 -24*n	B	2 Nulls: registration fill characters
4	24*n - 3600	I	Null fill

Band 6 Image Record Description:

Field	Bytes	Format	Description
1	1 - 2	B	2 Nulls: registration fill characters
2	3 - 24*n-4	I	Image data for Band 6, 1 byte per pixel
3	24*n-4 - 24*n	B	4 Nulls: registration fill characters

4	24*n - 3600	I	Null fill

Band 7 Image Record Description:

Field	Bytes	Format	Description
1	1 - 24*n-6	I	Image data for Band 7, 1 byte per pixel
2	24*n-6 - 24*n	B	6 Nulls: registration fill characters
3	24*n - 3600	I	Null fill

Note: The image Adjusted Line Length = 24n samples, where 135 <= n <= 144

2.3.2.2 Non Adjusted Line Length

MSS-X image data generated from raw wideband data do not have line length adjustments made, as indicated by “LINE LENGTH ADJUST = 0” in the header file. The image data files contain all sensor data from the start-of-scan code to the end-of- scan code. No corrections or adjustments are made to the data. The actual amount of image data can vary between each record. MSS-X image records are nominally aligned by the insertion of registration fill characters at the beginning of each line. In addition, the records are null-padded at the end to fill a fixed-size 3600-byte record.

Note: The band number descriptions range from 1 to 4, which represent MSS Bands 4 to 7 for Landsat 1-3 and MSS Bands 1 to 4 for Landsat 4-5.

Band 1 Image Record Description:

Field	Bytes	Format	Description
1	1 - 6	B	6 Nulls: registration fill characters
2	7 - X	I	Image data for first band, 1 byte per pixel
3	X - 3600	B	Null fill

Band 2 Image Record Description:

Field	Bytes	Format	Description
1	1 - 4	B	4 Nulls: registration fill characters
2	5 - X	I	Image data for second band, 1 byte per pixel
3	X - 3600	B	Null fill

Band 3 Image Record Description:

Field	Bytes	Format	Description
1	1 - 2	B	2 Nulls: registration fill characters
2	3 - X	I	Image data for third band, 1 byte per pixel
3	X - 3600	B	Null fill

Band 4 Image Record Description:

Field	Bytes	Format	Description
1	1 - X	I	Image data for fourth band, 1 byte per pixel
2	X - 3600	B	Null fill

Note: The amount of image data, X, varies from record to record and band to band.

2.3.3 Calibration Data Files

One calibration data file is generated for each band. It contains the full calibration wedge for each detector for alternating scans.

Field	Bytes	Format	Description
1	1-4	B	Length of calibration data
2	5-1404	B	Calibration data, converted to 8-bit bytes left-justified within field, null-filled (alternate scans)

The 6-bit calibration data values in this file are unsigned values and placed in the low order 6 bits of each byte. The calibration data were extracted from the scan to ensure that the entire calibration wedge fits within the record, but alignment of the wedge to any specific word in the record is not guaranteed.

Within an image, calibration records are assured to be aligned to alternating scans. If calibration could not be found on a scan where it was expected, a set of zero-filled calibration records will be placed in these files for the scan.

Appendix D of the “Generation and Physical Characteristics” documents listed in the References section describes the radiometric calibration approach. The Earth Resources Technology Satellite (ERTS) Data User’s Handbooks and the Landsat Data User’s Handbooks (see References) also describe the radiometric calibration approach.

2.3.4 Scan Data File

The scan data file contains the mirror scan and detector information for the scene. Partial scenes only contain scan information relevant to the imagery.

For the scan data files generated from the legacy WVTCS input data, some statistics are available per detector / track (line). For the scan data files generated from the raw wideband data, the per detector statistics are not available. In this case, the fields have the same value for each detector / band combination for that scan.

Field	Bytes	Format	Description
1	4	I	Scan number for this record. Values range from 0 to 389
2	8	F	Time stamp for this scan in DDDDHHMMSS.ff format. If the time stamp is the same for two consecutive records, it actually applies to the first of the two scans.
3	4	I	End scan position in pixels
4	4	I	Line length in pixels
5	4	I	Minor Frame Count 0 = Unknown or not calculated
6	4	I	Calibration wedge present flag 0 = Wedge not present 1 = Wedge present 2 = Wedge present but it is fill data
7	24	B	Data confidence for each detector / track 0 = Line start code found, high confidence

			1 = Line start code not found, transferred from other tracks 2 = Line start code not found, imagery null filled
8	24	B	Sync state indicator for each detector / track 0 = Good sync for entire scan 1 = No line length code found, possible sync loss 2 = No end scan code found, possible sync loss 3 = No line length code or end scan code found 4 = Minor frame sync errors detected
9	4	I	Time Code decommutation status 0 = Valid time code 1 = Interpolated time code 2 = Invalid time code
10	4	I	Time code format. The time code is assembled from the first two scans. A redundant time code, with a different format, is on the next two scan 0 = Time code format A 1 = Time code format B -1 = Unknown or Not Applicable
11	24	B	Number of time code bit majority failures for each detector / track 0 = All 6 bits the same 1 = One bit different 2 = Two bits different 3 = Majority vote failure 4 = Not Applicable
12	4	I	Number of end scan code majority vote failures -1 = Not applicable
13	4	I	Number of line length majority vote failures -1 = Not applicable
14	24	B	Indication of whether a bit slip was detected for each detector 0 = No 1 = Yes

2.3.5 Browse File

A multiband scene browse file is a reduced data volume file of the image data. These data can be viewed on a scene basis to determine general ground area coverage and spatial relationships between ground area coverage and cloud coverage. A multiband scene browse file contains data from three predetermined bands of data. The MACS generates a multiband scene browse file from each of the full resolution scenes contained in the three predetermined image data files (MSS Bands 7, 5, and 4 for Landsat 1-3; Bands 7, 5, 5 for Landsat 1 when Band 1 is not available; Bands 4, 2, 1 for Landsat 4-5; Bands 3, 2, 1 for Landsat 5 when Band 4 is not available) and generates a standard JPEG formatted file.

The size of each browse file depends on the image data content and how much data compression can be obtained. Typically, the browse file size average is 65 Kilobyte (KB).

Appendix A Glossary

Orphans: During the Wideband Video Tape conversion, almost half of the wideband tapes did not have corresponding metadata from the DIAT or SLAT files. Hence, no scenes were identified; the data were declared to be MSS-X orphan data and saved for future processing. Metadata for these MSS-X orphan scenes have now been generated, allowing these scenes to be processed through MACS. Recently acquired MSS data (either live downlinks or historical data received from other receiving stations) also are considered orphan data as the metadata required to frame the scene is not available and must be generated.

References

See http://landsat.usgs.gov/tools_acronyms_ALL.php for a list of acronyms.

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Thomas, Valerie L. Generation and Physical Characteristics of the LANDSAT-1, -2 and -3 MSS Computer Compatible Tape, Revision of X-563-75-223. Goddard Space Flight Center, Greenbelt, Maryland. December 1977.

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ERTS Data User's Handbook, Document No. 71SD4249. Goddard Space Flight Center, Greenbelt, Maryland. September 15, 1971.

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