4.0 REAL TIME DATA SYSTEMS FOR LOCAL USERS

This section describes the real-time systems which are available for NOAA KLM direct readout users. These systems include the High Resolution Picture Transmission (HRPT), the Automatic Picture Transmission (APT), Direct Sounder Broadcast (DSB) and the Data Collection System (DCS). Transmission characteristics, data frame formats and synchronization details are given for each of the above mentioned systems.

4.1 HRPT SYSTEM

4.1.1 GENERAL

The High Resolution Picture Transmission (HRPT) system provides data from all spacecraft instruments at a rate of 665,400 bps. The S-band realtime transmission consists of the digitized unprocessed output of five AVHRR/3 channels, plus the TIP (HIRS/3, SBUV/2, SEM, and DCS/2) data and AMSU data. All information necessary to calibrate the instrument outputs is included in the data stream.

During NOAA-K activation and evaluation, it was determined that AMSU-A channels 7 and 15 were switched. This switch should be transparent to Level 1b users as the channels were corrected (switched back) by the ingest software, however, direct readout users should be aware of this problem. Only the radiometric data was affected, the housekeeping temperatures of channels 15 and 7 oscillators are correct as they are now. The antenna patterns, beam efficiency and beam widths are correct as they were not affected by the switch. Band pass for channels 7 and 15 was not affected due to extremely broad rf-detectors.

4.1.2 TRANSMISSION CHARACTERISTICS

The S-band transmission of time multiplexed, digital data is in a split phase format. For NOAA KLM, split phase data "0" is defined as being +68 degrees phase during the first half of the bit period and -68 degrees during the second half of the bit period. The split phase data "1" is defined as being -68 degrees phase during the first half of the bit period and +68 degrees phase during the second half of the bit period, for NOAA KLM. Note, the NOAA-N,-N satellites have a slightly different phase angle (see Table 4.1.2-2). Table 4.1.2-1 shows the general characteristics of the HRPT transmission system, while the general HRPT parameters for both NOAA KLM and NOAA-N,-N are shown in Table 4.1.2-2.

Table 4.1.2-1. HRPT Transmission Characteristics.

Line Rate	360 lines/minute
Data Channels	5 transmitted, 6 available
Data Resolution	1.1 km
Carrier Modulation	Digital split phase, phase modulated

Transmitter Frequency (MHz)	1698.0 or 1707.0 MHz primary, 1702.5 MHz secondary For the latest information on individual POES spacecraft , refer to NOAA/NESDIS/OSO's website: http://www.oso.noaa.gov/poesstatus/index.asp
Transmitter Power (EOL)	6.35 W (38.03 dBm)
Radiated Power (dBm, @ 63 degrees)	40.13
Polarization: STX1 STX2 STX3	 RCP LCP* RCP
* Except when STX2 is connected to the emergency omni antenna which is also RCP.	

Table 4.1.2-2. HRPT Parameters for NOAA KLM and NOAA-N,-N'.

Parameter	NOAA KLM	NOAA-N,-N'
Major Frame		
Rate	2 major frames/sec	2 major frames/sec
Minor Frames/Major Frame	3	3
Minor Frame		
Rate	6 minor frames/sec	6 minor frames/sec
Number of words	11,090	11,090
Format	See Table 4.1.3.1-1	See Table 4.1.3.2-1
Word Parameters		
Rate	66,540 words/sec	66,540 words/sec
Number of bits/word	10	10
Order	Bit 1=MSB, Bit 10=LSB	Bit 1=MSB, Bit 10=LSB
Bit Parameters		
Rate	665,400 bits/sec	665,400 bits/sec
Format	Split phase	Split phase
Data "0"	+68/-68 degrees	+67/-67 degrees
Data "1"	-68/+68 degrees	-67/+67 degrees

4.1.3 HRPT MINOR FRAME FORMAT

The MIRP outputs the HRPT format simultaneously with the Automatic Picture Transmission (APT), Global Area Coverage (GAC) and Local Area Coverage (LAC) formats. GAC and LAC data are not considered real time, as these data are stored on the spacecraft digital recorders for readout by the CDA stations. The HRPT data format consists of a major frame which is subdivided into three minor frames.

Of special note is the flag in the telemetry (Word 7, Bit 10) which will indicate which of AVHRR/3 channel 3 sensors (3A or 3B) is operating. When channel 3B is selected, the patch temperature data is output every scan line (during the backscan), and every other scan line when channel 3A is selected. The data output will switch instantaneously between 3A and 3B upon

command, even if the scan is in the middle of a line. However, the way the flag operates there is one scan line of uncertainty when switching from 3B to 3A, and two lines of uncertainty when switching from 3A to 3B.

4.1.3.1 HRPT Minor Frame Format for NOAA KLM

On NOAA KLM, TIP and AMSU data are updated at the major frame rate. That is, the three minor frames which make up the major frame will contain TIP data in the first minor frame, backfill in the second minor frame, and AMSU data from the AIP, in the third minor frame. In the previous series of satellites (NOAA E-J), the major frame consisted of three minor frames of only the TIP data. The details of the HRPT, AIP, and TIP minor frame formats for NOAA KLM are shown in Tables 4.1.3.1-1, 4.1.5.1-1 and 4.3.3.1-1, respectively.

Of special note here is the flag in the telemetry (Word 7, Bit 10) which will indicate which of AVHRR/3 channel 3 sensors (3A or 3B) is operating. When channel 3B is selected, the patch temperature data is output every scan line (during the backscan), and every other scan line when channel 3A is selected. The data output will switch instantaneously between 3A and 3B upon command, even if the scan is in the middle of a line. However, the way the flag operates there is one scan line of uncertainty when switching from 3B to 3A, and two lines of uncertainty when switching from 3A to 3B.

Table 4.1.3.1-1 describes the minor frame format for HRPT on the NOAA KLM satellites.

Table 4.1.3.1-1. HRPT Minor Frame Format for NOAA KLM.

Function	No. of Words	Word Position	Bit No. 1 2 3 4 5 6 7 8 9 10 Plus Word Code & Meaning	Notes
Frame Sync	6	1	1 0 1 0 0 0 0 1 0 0	
		2	0 1 0 1 1 0 1 1 1 1	
		3	1 1 0 1 0 1 1 1 0 0	1
		4	0 1 1 0 0 1 1 1 0 1	
		5	1 0 0 0 0 0 1 1 1 1	
		6	0 0 1 0 0 1 0 1 0 1	
ID	2	7	Bit 1; 0=Internal Sync; 1=AVHRR Sync Bits 2 & 3; 00=Not an HRPT frame but a GAC frame; 01=Minor Frame #1; 10=Minor Frame #2; 11=Minor Frame #3 Bits 4-7; Spacecraft Addresses; Bit 4=MSB, BIT 7=LSB Bit 8; 0=Frame Stable; 1=Frame Resync Occurred Bit 9; 1=Normal AVHRR input, 0=PN AVHRR Input Bit 10; 0=AVHRR Ch3B, 1=AVHRR Ch3A	
		8	Bits 1-10; undefined Spare	

Time Code	4	9	Bits 1-9; Binary day count; Bit 1 = MSB; Bit 9 = LSB Bit 10; 0; spare	
		10	Bit 1-3; 101, spare Bits 4-10; Part of Binary msec of day count; Bit 4=MSB	
		11	Bit 1-10; Part of Binary msec of day count;	
		12	Bit 1-10; Remainder of Binary msec of day count; Bit 10=LSB	
Telemetry	10	13	Ramp Calibration AVHRR Channel #1	
		14	Ramp Calibration AVHRR Channel #2	
		15	Ramp Calibration AVHRR Channel #3	
		16	Ramp Calibration AVHRR Channel #4	
		17	Ramp Calibration AVHRR Channel #5	
		18	PRT Reading 1	
		19	PRT Reading 2	
		20	PRT Reading 3	2
		21	Channel 3 patch Temp.	
		22	Spare - Undefined	
Calibration Target View	30	23 thru 52	10 words of calibration target view data from each AVHRR channel 3, 4, and 5. These data are time multiplexed as chan 3 (word 1), chan 4 (word 1), chan 5 (word 1), chan 3 (word 2), chan 4 (word 2), chan 5 (word 2), etc.	
Space Data	50	53 thru 102	10 words of space scan data from each AVHRR channel 1, 2, 3, 4, and 5. These data are time multiplexed as chan 1 (word 1), chan 2 (word 1), chan 3 (word 1), chan 4 (word 1) chan 5 (word 1), chan 1 (word 2), chan 2 (word 2), chan 3 (word 2), chan 4 (word 2), chan 5 (word 2), etc.	
Sync Data	1	103	Bit 1; 0 = AVHRR sync early; 1 = AVHRR sync late, Bits 2-10; 9 bit binary count of 0.9984 MHz periods; Bit 2 = MSB, Bit 10=LSB	
Data Words	520	104 thru 623	3 sets of data corresponding to three HRPT minor frames per HRPT major frame. First HRPT minor frame: The 520 words contain 5 TIP minor frames of TIP data (104 TIP data words per TIP minor frame) Bits 1-8: Exact format as generated by TIP. Bit 9: Even parity check over Bits 1-8. Bit 10: Inverted Bit 1.	3

			Second HRPT minor frame: The 520 words shall consist of five frames (104 words per frame) of spare data in the same form as spare words 624-750. Third HRPT minor frame: The 520 words shall consist of five frames (104 words per frame)of AMSU data from the AIP. Bits 1-8: Exact format as generated by AIP. Bit 9: Even parity check over Bits 1-8. Bit 10: Inverted Bit 1.	
Spare Words	127	624	1 0 1 0 0 0 1 1 1 0	
		625	1 1 1 0 0 0 1 0 1 1	
		626	0 0 0 0 1 0 1 1 1 1	
		627	1 0 1 1 0 0 0 1 1 1	
		628	1 1 0 1 0 1 0 0 1 0	
		...	...	4
		748	1 0 0 1 0 1 1 0 1 0	
		749	1 1 0 0 1 0 0 0 1 0	
		750	1 0 0 0 0 0 0 0 0 0	
Earth Data	10,240	751	Chan 1 - Sample 1	
		752	Chan 2 - Sample 1	
		753	Chan 3 - Sample 1	
		754	Chan 4 - Sample 1	
		755	Chan 5 - Sample 1	
		756	Chan 1 - Sample 2	
		...	...	5
		10,985	Chan 5 - Sample 2047	
		10,986	Chan 1 - Sample 2048	
		10,987	Chan 2 - Sample 2048	
		10,988	Chan 3 - Sample 2048	
		10,989	Chan 4 - Sample 2048	
		10,990	Chan 5 - Sample 2048	
Auxiliary Sync	100	10,991	1 1 1 1 1 0 0 0 1 0	
		10,992	1 1 1 1 1 1 0 0 1 1	
		10,993	0 1 1 0 1 1 0 1 0 1	
		10,994	1 0 1 0 1 1 1 1 0 1	
		...	...	6
		11,089		
		11,090		

Notes:
1) First 60 bits from 63 bit PN generator started in the all 1's state. The generator polynomial is $X^6+X^5+X^2+X+1$
2) AVHRR Internal Target Temperature Data. Three readings from one of the four platinum resistance thermometers (PRT). A different PRT is sampled for each scan; every fifth scan will contain a reference value of 0 in place of each reading.
3) 104 words includes 103 words of the AMSU frame plus the first word of TIP
4) Derived by inverting the output of a 1023 bit PN sequence provided by a feedback shift register generating the polynomial: $X^{10}+X^5+X^2+X+1$. The generator is started in all 1's state at the beginning of word 7 of each minor frame.
5) Each minor frame contains the data obtained during one Earth scan of the AVHRR sensor. The data from the five sensor channels of the AVHRR are time multiplexed as indicated.
6) Derived from the non-inverted output of a 1023 bit PN sequence provided by a feedback shift register generating the polynomial: $X^{10}+X^5+X^2+X+1$. The generator is started in the all 1's state at the beginning of word 10,991.

4.1.3.2 HRPT Minor Frame Format for NOAA-N,-N'

On NOAA-N,-N', the HRPT format provides a major frame, which is made up of three minor frames. TIP and AMSU/MHS data are updated at the major frame rate. That is, the three minor frames, which make up a major frame, will contain TIP data in the first minor frame, backfill in the second minor frame, and AMSU/MHS data in the third minor frame. The HRPT is provided in a split phase format to the S-Band Transmitter. The S-band transmission of time multiplexed, digital data is in a split phase format. The split phase data 0" is defined as being $+67^o$ phase during the first half of the bit period and -67^o phase during the second half of the bit period. The split phase data 1" is defined as being -67^o phase during the first half of the bit period and $+67^o$ during the second half of the bit period. The time code contained in each minor frame indicates the spacecraft time 1.13 $\pm$ 0.5 milliseconds before the beginning of bit 1 of word 1. The HRPT minor frame format for NOAA-N,-N' is shown in Table 4.1.3.2-1.

Table 4.1.3.2-1. HRPT Minor Frame Format for NOAA-N, -N'.

Function	No. of Words	Word Position	Bit No. Plus Word Code & 1 2 3 4 5 6 7 8 9 10 Meaning	Notes
Frame Sync	6	1	1 0 1 0 0 0 0 1 0 0	
		2	0 1 0 1 1 0 1 1 1 1	
		3	1 1 0 1 0 1 1 1 0 0	1
		4	0 1 1 0 0 1 1 1 0 1	
		5	1 0 0 0 0 0 1 1 1 1	
		6	0 0 1 0 0 1 0 1 0 1	
ID	2	7	Bit 1; 0=Internal Sync; 1=AVHRR Sync Bits 2 & 3; 00=Not an HRPT frame but a GAC frame; 01=Minor Frame #1; 10=Minor Frame #2; 11=Minor Frame #3 Bits 4-7; Spacecraft Addresses; Bit 4=MSB, BIT 7=LSB	

			Bit 8; 0=Frame Stable; 1=Frame Resync Occurred Bit 9; 1=Normal AVHRR input, 0=PN AVHRR Input Bit 10; 0=AVHRR Ch3A, 1=AVHRR Ch3B	
		8	Bits 1-10; undefined Spare	
Time Code	4	9	Bits 1-9; Binary day count; Bit 1 = MSB; Bit 9 = LSB Bit 10; 0; spare	
		10	Bit 1-3; 101, spare Bits 4-10; Part of Binary msec of day count; Bit 4=MSB	
		11	Bit 1-10; Part of Binary msec of day count;	
		12	Bit 1-10; Remainder of Binary msec of day count; Bit 10=LSB	
Telemetry	10	13	Ramp Calibration AVHRR Channel #1	
		14	Ramp Calibration AVHRR Channel #2	
		15	Ramp Calibration AVHRR Channel #3	
		16	Ramp Calibration AVHRR Channel #4	
		17	Ramp Calibration AVHRR Channel #5	
		18	AVHRR Channel #3 Target Temperature	
		19	AVHRR Channel #4 Target Temperature	
		20	AVHRR Channel #5 Target Temperature	2
		21	Channel 3 patch Temp.	
		22	Spare - Undefined	
Back Scan	30	23 thru 52	10 words of back scan data from each AVHRR channel 3, 4, and 5. These data are time multiplexed as chan 3 (word 1), chan 4 (word 1), chan 5 (word 1), chan 3 (word 2), chan 4 (word 2), chan 5 (word 2), etc.	
Space Data	50	53 thru 102	10 words of space scan data from each AVHRR channel 1, 2, 3, 4, and 5. These data are time multiplexed as chan 1 (word 1), chan 2 (word 1), chan 3 (word 1), chan 4 (word 1) chan 5 (word 1), chan 1 (word 2), chan 2 (word 2), chan 3 (word 2), chan 4 (word 2), chan 5 (word 2), etc.	
Sync Data	1	103	Bit 1; 0 = AVHRR sync early; 1 = AVHRR sync late, Bits 2-10; 9 bit binary count of 0.9984 MHz periods; Bit 2 = MSB, Bit 10=LSB	

Data Words	520	104 thru 623	3 sets of data corresponding to three HRPT minor frames per HRPT major frame. First HRPT minor frame: The 520 words contain 5 TIP minor frames of TIP data (104 TIP data words per TIP minor frame) Bits 1-8: Exact format as generated by TIP. Bit 9: Even parity check over Bits 1-8. Bit 10: Inverted Bit 1. Second HRPT minor frame: The 520 words shall consist of five frames (104 words per frame) of spare data in the same form as spare words 624-750. Third HRPT minor frame: The 520 words shall consist of five frames (104 words per frame)of AMSU/MHS data from the AIP. Bits 1-8: Exact format as generated by AIP. Bit 9: Even parity check over Bits 1-8. Bit 10: Inverted Bit 1.	3
Spare Words	127	624	0 1 0 0 0 0 1 0 0 1	
		625	0 1 1 1 1 0 1 1 1 0	
		626	1 1 1 0 1 0 1 0 1 0	
		627	0 0 1 1 1 0 1 1 1 0	
		628	0 0 1 0 1 1 0 0 0 0	
		...	...	4
		748	1 0 1 1 0 1 1 1 0 1	
		749	0 0 0 1 0 0 1 1 1 0	
		750	1 1 1 1 0 0 1 0 0 1	
Earth Data	10,240	751	Chan 1 - Sample 1	
		752	Chan 2 - Sample 1	
		753	Chan 3 - Sample 1	
		754	Chan 4 - Sample 1	
		755	Chan 5 - Sample 1	
		756	Chan 1 - Sample 2	
		...	...	5
		10,985	Chan 5 - Sample 2047	
		10,986	Chan 1 - Sample 2048	
		10,987	Chan 2 - Sample 2048	
		10,988	Chan 3 - Sample 2048	
		10,989	Chan 4 - Sample 2048	
		10,990	Chan 5 - Sample 2048	
Auxiliary Sync	100	10,991	1 1 1 1 1 0 0 0 1 0	

		10,992	1 1 1 1 1 1 0 0 1 1	
		10,993	0 1 1 0 1 1 0 1 0 1	
		10,994	1 0 1 0 1 1 1 1 0 1	
		...	...	6
		11,089	0 1 1 1 1 1 0 0 0 0	
		11,090	1 1 1 1 0 0 1 1 0 0	

NOTES:
1. First 60 bits from 63 bit PN generator started in the all 1's state. The generator polynomial is $X^6+X^5+X^2+X+1$
2. Each of these words is a 5 channel subcom; 4 words of IR data plus subcom sync (10 A0"s)
3. The 104th word of each AMSU/MHS data frame of the MIRP contains 1110110100.
4. Derived by inverting the output of a 1023 bit PN sequence provided by a feedback shift register generating the polynomial: $X^{10}+X^5+X^2+X+1$. The generator is started in all 1's state at the beginning of word 7 of each minor frame.
5. Each minor frame contains the data obtained during one Earth scan of the AVHRR sensor. The data from the five sensor channels of the AVHRR are time multiplexed as indicated.
6. Derived from the non-inverted output of a 1023 bit PN sequence provided by a feedback shift register generating the polynomial: $X^{10}+X^5+X^2+X+1$. The generator is started in the all 1's state at the beginning of word 10,991.

4.1.4 DIGITAL "A" TELEMETRY

The output data signals supplied by the instrument to the spacecraft can be assigned to three categories: 1) instrument Digital “A” (scientific) data; 2) Digital “B” Telemetry; and 3) Analog Telemetry. For purposes of this document, Digital “A” data are described in this section

4.1.4.1 AMSU-A1 for NOAA KLM

The AMSU-A1 Digital "A" telemetry incorporates all of the radiometric data taken during one scan. It also includes the data from the on-orbit calibrations. In the Full Scan Mode, the AMSU-A1 for NOAA KLM and NOAA-N, N' has 1,244 Digital "A" telemetry points, as identified in Table 4.1.4.1-1.

Table 4.1.4.1-1. AMSU-A1 Digital “A” Data Format - Full Scan Mode for NOAA KLM.

A1 Frame Byte Number	Parameter
1-3	Sync. Sequence (FF Hex)
4	Unit Identification and Serial Number
5	Digital Housekeeping Data 1
6	Digital Housekeeping Data 2
7	Digital Housekeeping Data 3
8	Digital Housekeeping Data 4
9	Reflector 1, Position 1, MSP, First reading
10	Reflector 1, Position 1, LSP, First reading
11	Reflector 2, Position 1, MSP, First reading

12	Reflector 2, Position 1, LSP, First reading
13	Reflector 1, Position 1, MSP, Second reading
14	Reflector 1, Position 1, LSP, Second reading
15	Reflector 2, Position 1, MSP, Second reading
16	Reflector 2, Position 1, LSP, Second reading
17	Scene Position 1, Channel 3, MSP
18	Scene Position 1, Channel 3, LSP
19	Scene Position 1, Channel 4, MSP
20	Scene Position 1, Channel 4, LSP
...	...
41	Scene Position 1, Channel 15, MSP
42	Scene Position 1, Channel 15, LSP
43	Reflector 1, Position 2, MSP, First reading
44	Reflector 1, Position 2, LSP, First reading
45	Reflector 2, Position 2, MSP, First reading
46	Reflector 2, Position 2, LSP, First reading
47	Reflector 1, Position 2, MSP, Second reading
48	Reflector 1, Position 2, LSP, Second reading
49	Reflector 2, Position 2, MSP, Second reading
50	Reflector 2, Position 2, LSP, Second reading
51	Scene Position 2, Channel 3, MSP
52	Scene Position 2, Channel 3, LSP
...	...
75	Scene Position 2, Channel 15, MSP
76	Scene Position 2, Channel 15, LSP
77	Reflector 1, Position 3, MSP, First reading
78	Reflector 1, Position 3, LSP, First reading
79	Reflector 2, Position 3, MSP, First reading
80	Reflector 2, Position 3, LSP, First reading
81	Reflector 1, Position 3, MSP, Second reading
82	Reflector 1, Position 3, LSP, Second reading
83	Reflector 2, Position 3, MSP, Second reading
84	Reflector 2, Position 3, LSP, Second reading
85	Scene Position 3, Channel 3, MSP
86	Scene Position 3, Channel 3, LSP
...	...
1027	Scene Position 30, Channel 15, MSP
1028	Scene Position 30, Channel 15, LSP
1029	Reflector 1, Cold Cal. Position, MSP, First reading
1030	Reflector 1, Cold Cal. Position, LSP, First reading
1031	Reflector 2, Cold Cal. Position, MSP, First reading
1032	Reflector 2, Cold Cal. Position, LSP, First reading
1033	Reflector 1, Cold Cal. Position, MSP, Second reading

1034	Reflector 1, Cold Cal. Position, LSP, Second reading
1035	Reflector 2, Cold Cal. Position, MSP, Second reading
1036	Reflector 2, Cold Cal. Position, LSP, Second reading
1037	Cold Calibration 1, Channel 3, MSP
1038	Cold Calibration 1, Channel 3, LSP
1039	Cold Calibration 1, Channel 4, MSP
1040	Cold Calibration 1, Channel 4, LSP
...	...
1061	Cold Calibration 1, Channel 15, MSP
1062	Cold Calibration 1, Channel 15, LSP
1063	Cold Calibration 2, Channel 3, MSP
1064	Cold Calibration 2, Channel 3, LSP
1065	Cold Calibration 2, Channel 4, MSP
1066	Cold Calibration 2, Channel 4, LSP
...	...
1087	Cold Calibration 2, Channel 15, MSP
1088	Cold Calibration 2, Channel 15, LSP
1089	Temp Sensor 1, MSP
1090	Temp Sensor 1, LSP
1091	Temp Sensor 2, MSP
1092	Temp Sensor 2, LSP
...	...
1177	Temp Sensor 45, MSP
1178	Temp Sensor 45, LSP
1179	Temp Sensor Reference Voltage, MSP
1180	Temp Sensor Reference Voltage, LSP
1181	Reflector 1 Warm Cal. Position, MSP, First reading
1182	Reflector 1 Warm Cal. Position, LSP, First reading
1183	Reflector 2 Warm Cal. Position, MSP, First reading
1184	Reflector 2 Warm Cal. Position, LSP, First reading
1185	Reflector 1 Warm Cal. Position, MSP, Second reading
1186	Reflector 1 Warm Cal. Position, LSP, Second reading
1187	Reflector 2 Warm Cal. Position, MSP, Second reading
1188	Reflector 2 Warm Cal. Position, LSP, Second reading
1189	Warm Calibration 1, Channel 3, MSP
1190	Warm Calibration 1, Channel 3, LSP
...	...
1213	Warm Calibration 1, Channel 15, MSP
1214	Warm Calibration 1, Channel 15, LSP
1215	Warm Calibration 2, Channel 3, MSP
1216	Warm Calibration 2, Channel 3, LSP
...	...
1239	Warm Calibration 2, Channel 15, MSP

1240	Warm Calibration 2, Channel 15, LSP
...	...
1241-1243	Sync. Sequence (FF Hex)
1244	nit Identification and Serial Number

Notes:

1. The MSP is the most significant portion of a particular measurement; the LSP is the least significant portion of the particular measurement.
2. The first set of readings for a particular reflector position are made prior to the integration interval; the second set of readings are made approximately halfway through the integration period.
3. Digital "A" data as read by the spacecraft shall contain an undetermined number of "fill words". These fill words shall be 0001H and will be intermingled with valid data. The Digital "A" data as sent by the instrument shall be such that no valid data of 0001H shall be included.
4. Format of Position data is: DDDDDDDDDDDDDE0, where:
D = Data
E = Error bit: 0=not in spec, 1=spec.
0 = Zero
5. Format of Radiometer data is: DDDDDDDDDDDDDD0, where:
D = Data
0 = Zero
6. Temperature Sensor Reference Voltage utilized for temperature sensors 36-45 only.

Table 4.1.4.1-2. AMSU-A1 Data Word Description

Housekeeping Data, Byte Number 1	
Bit #	**Description**
0	0
1	Full Scan Mode: 0 = Not Full Scan Mode; 1 = Full Scan.
2	Warm Cal Mode: 0 = Not in Warm Cal; 1 = Warm Cal.
3	Cold Cal Mode: 0 = Not in Cold Cal; 1 = Cold Cal.
4	Nadir Mode: 0 = Not in Nadir; 1 = Nadir
5	Cold Cal Position, LSB
6	Cold Cal Position, MSB
7	0
Housekeeping Data, Byte Number 2	
0	0
1	Scanner A1-1 Power:

	0 = Off; 1 = On.
2	Scanner A1-2: 0 = Off 1 = On.
3	PLL Power: 0 = Redundant (PLO #2) 1 = Primary (PLO #1).
4	Survival Heater Power: 0 = Off; 1 = On.
5	0
6	0
7	0
Housekeeping Data, Byte 3	
0	0
1	0
2	0
3	0
4	0
5	0
6	0
7	0
Housekeeping Data, Byte 4	
0	0
1	0
2	0
3	0
4	0
5	0
6	0
7	0
Temperature Sensor Assignments	
Number	**Location**
1	Scan Motor A1-1
2	Scan Motor A1-2
3	Feedhorn A1-1
4	Feedhorn A1-2
5	RF Mux A1-1
6	RF Mux A1-2
7	Local Oscillator Channel 3
8	Local Oscillator Channel 4
9	Local Oscillator Channel 5
10	Local Oscillator Channel 6

11	Local Oscillator Channel 7
12	Local Oscillator Channel 8
13	Local Oscillator Channel 15
14	PLL LO #2 Channels 9 through 14 (See Note 1)
15	PLL LO#1 Channels 9 through 14
16	PLLO (Reference Oscillator) for S/N 101-104, Not Used for S/N 105-109
17	Mixer/IF Amplifier Channel 3
18	Mixer/IF Amplifier Channel 4
19	Mixer/IF Amplifier Channel 5
20	Mixer/IF Amplifier Channel 6
21	Mixer/IF Amplifier Channel 7
22	Mixer/IF Amplifier Channel 8
23	Mixer/IF Amplifier Channel 9/14
24	Mixer/IF Amplifier Channel 15
25	IF Amplifier Channel 11/14
26	IF Amplifier Channel 9
27	IF Amplifier Channel 10
28	IF Amplifier Channel 11
29	DC/DC Converter
30	IF Amplifier Channel 13
31	IF Amplifier Channel 14
32	IF Amplifier Channel 15
33	RF Shelf A1-1
34	RF Shelf A1-2
35	Detector/Preamplifier Assembly
36	A1-1 Warm Load 1 – Not Valid for S/N 103
37	A1-1 Warm Load 2
38	A1-1 Warm Load 3
39	A1-1 Warm Load 4
40	A1-1 Warm Load Center
41	A1-2 Warm Load 1
42	A1-1 Warm Load 2
43	A1-1 Warm Load 3
44	A1-1 Warm Load 4
45	A1-1 Warm Load Center

AMSU A-1 Identification Words

Unit Number	Identification No. (Binary)	S/N
Engineering Model Module A1	00000001	101
Proto Flight Model Module A1	00000101	102
Flight Model 1 Module A1	00001001	103
Flight Model 2 Module A1	00001101	104

Flight Model 3 Module A1	00010001	105
Flight Model 4 Module A1	00010101	106
Flight Model 5 Module A1	00011001	107
Flight Model 6 Module A1	00011101	108
Flight Model 7 Module A1	00100001	109

Note:
1) For S/N 102: Read PRT temperature. Read voltage of lock detect signal and covert to temperature using the following formula: t = (8.73 X V) – 23.5 where t is the temperature (in C) and V is the measured lock detect voltage signal. If the temperature given by the PRT reading and the formula are in agreement within ± 5C, then use the PRT reading as it was intended. If the temperature difference is greater than ± 5C, then use the temperature interpreted from lock detect signal. At initial power on of PLLO#2 before PLLO#2 is fully self heated and stabilized, use within ± 5C rule with reference A1-1 (PRT #33) RF -shelf temperature. The within ± 5C rule does not apply right after PLLO was operational and was switched off and then back on. In this case, wait half an hour for PLLO#2 to cool down before temperature extraction method can be selected correctly. The formula t = (8.75 X V) -23.5 is usable only between 2.5V to +8.4V or -1.6 to 50 C.

4.1.4.2 AMSU-A2 for NOAA KLM

The AMSU-A2 Digital "A" telemetry incorporates all of the radiometric data taken during one scan. It also includes the data from the on-orbit calibrations. The AMSU-A2 has 316 Digital "A" telemetry points, as described in Table 4.1.4.2-1, in the Full Scan Mode.

Table 4.1.4.2-1. AMSU-A2 Digital "A" Format - Full Scan Mode for NOAA KLM.

A2 Frame Byte Number	Parameter
1-3	Sync. Sequence (FF Hex)
4	Unit Identification and Serial Number
5	Digital Housekeeping Data 1
6	Digital Housekeeping Data 2
7	Digital Housekeeping Data 3
8	Digital Housekeeping Data 4
9	Reflector, Position 1, MSP, First reading
10	Reflector, Position 1, LSP, First reading
11	Reflector, Position 1, MSP, Second reading
12	Reflector, Position 1, LSP, Second reading
13	Scene Position 1, Channel 1, MSP
14	Scene Position 1, Channel 1, LSP
15	Scene Position 1, Channel 2, MSP
16	Scene Position 1, Channel 2, LSP
17	Reflector, Position 2, MSP, First reading
18	Reflector, Position 2, LSP, First reading
19	Reflector, Position 2, MSP, Second reading
20	Reflector, Position 2, LSP, Second reading

21	Scene Position 2, Channel 1, MSP
22	Scene Position 2, Channel 1, LSP
23	Scene Position 2, Channel 2, MSP
24	Scene Position 2, Channel 2, LSP
25	Reflector, Position 3, MSP, First reading
26	Reflector, Position 3, LSP, First reading
27	Reflector, Position 3, MSP, Second reading
28	Reflector, Position 3, LSP, Second reading
29	Scene Position 3, Channel 1, MSP
30	Scene Position 3, Channel 1, LSP
...	...
247	Scene Position 30, Channel 2, MSP
248	Scene Position 30, Channel 2, LSP
249	Reflector, Cold Calibration Position, MSP, First reading
250	Reflector, Cold Calibration Position, LSP, First reading
251	Reflector, Cold Calibration Position, MSP, Second reading
252	Reflector, Cold Calibration Position, LSP, Second reading
253	Cold Calibration 1, Channel 1, MSP
254	Cold Calibration 1, Channel 1, LSP
255	Cold Calibration 1, Channel 2, MSP
256	Cold Calibration 1, Channel 2, LSP
257	Cold Calibration 2, Channel 1, MSP
258	Cold Calibration 2, Channel 1, LSP
259	Cold Calibration 2, Channel 2, MSP
260	Cold Calibration 2, Channel 2, LSP
261	Temperature Sensor 1, MSP
262	Temperature Sensor 1, LSP
263	Temperature Sensor 2, MSP
264	Temperature Sensor 2, LSP
...	...
297	Temperature Sensor 19, MSP
298	Temperature Sensor 19, LSP
299	Temperature Sensor Reference Voltage, MSP
300	Temperature Sensor Reference Voltage, LSP
301	Reflector Warm Calibration Position, MSP, First reading
302	Reflector Warm Calibration Position, LSP, First reading
303	Reflector Warm Calibration Position, MSP, Second reading
304	Reflector Warm Calibration Position, LSP, Second reading
305	Warm Calibration 1, Channel 1, MSP

306	Warm Calibration 1, Channel 1, LSP
307	Warm Calibration 1, Channel 2, MSP
308	Warm Calibration 1, Channel 2, LSP
309	Warm Calibration 2, Channel 1, MSP
310	Warm Calibration 2, Channel 1, LSP
311	Warm Calibration 2, Channel 2, MSP
312	Warm Calibration 2, Channel 2, LSP
313-315	Synchronization Sequence (FF Hex)
316	Unit Identification and Serial Number

Notes:

1. MSP is the most significant portion of a particular measurement while the LSP is the least significant portion of the particular measurement.

2) The first set of readings for a particular reflector position are made prior to the integration interval; the second set of readings are made approximately half way through the integration period.

3) Digital "A" data as read by the spacecraft shall contain an undetermined number of "fill words". These fill words shall be 0001H and will be intermingled with valid data. The Digital "A" data as sent by the instrument shall be such that no valid data of 0001H shall be included.

4) Format of Position data is DDDDDDDDDDDDDE0, where:
D=Data
E=Error bit: 0=not in spec, 1=spec.
0=Zero

5) Format of Radiometer data is DDDDDDDDDDDDDD0, where:
D=Data
0=Zero

6) Temperature sensor reference voltage is utilized for temperature sensors 13 through 19 only.

Table 4.1.4.2-2. AMSU-A1 Data Word Description

Housekeeping Data, Byte Number 1

Bit #	Description
0	0
1	Full Scan Mode: 0 = Not Full Scan Mode; 1 = Full Scan.
2	Warm Cal Mode: 0 = Not in Warm Cal; 1 = Warm Cal.
3	Cold Cal Mode: 0 = Not in Cold Cal; 1 = Cold Cal.
4	Nadir Mode: 0 = Not in Nadir; 1 = Nadir

5	Cold Cal Position, LSB
6	Cold Cal Position, MSB
7	0
Housekeeping Data, Byte Number 2	
0	0
1	Scanner A2: 0 = Off 1 = On.
2	Scanner Compensator Power: 0 = Off; 1 = On.
3	0
4	Survival Heater Power: 0 = Off; 1 = On.
5	0
6	0
7	0
Housekeeping Data, Byte 3	
0	0
1	0
2	0
3	0
4	0
5	0
6	0
7	0
Housekeeping Data, Byte 4	
0	0
1	0
2	0
3	0
4	0
5	0
6	0
7	0
Temperature Sensor Assignments	
Number	**Location**
1	Scan Motor
2	Feed Horn
3	RF Mux
4	Mixer IF Amplifier Channel 1
5	Mixer IF Amplifier Channel 2
6	Local Oscillator Channel 1

7	Local Oscillator Channel 2
8	Compensation Motor
9	Subreflector
10	DC/DC Converter
11	RF Shelf
12	Detector/Preamp Assembly
13	Warm Load Center
14	Warm Load 1
15	Warm Load 2
16	Warm Load 3
17	Warm Load 4
18	Warm Load 5
19	Warm Load 6

AMSU A-1 Identification Words

Unit Number	Identification No. (Binary)	S/N
Engineering Model Module A2	00000010	101
Proto Flight Model Module A2	00000110	102
Flight Model 1 Module A2	00001010	103
Flight Model 2 Module A2	00001110	104
Flight Model 3 Module A2	00010010	105
Flight Model 4 Module A2	00010110	106
Flight Model 5 Module A2	00011010	107
Flight Model 6 Module A2	00011110	108
Flight Model 7 Module A2	00100010	109

4.1.4.3 AMSU-B for NOAA KLM

Digital "A" Data is clocked into the spacecraft AIP at a 16.64 kbps rate by the shift pulse whenever the Data Enable Pulse is presented to the instrument. The AMSU-B data is in the AIP minor frame words 48 through 97. The AIP reads the digital data output from the AMSU-B in 16 bit words.

The AMSU-B telemetry format consists of 78 minor frames of data. Minor frames 1 and 80 in each 8 second cycle are blank: i.e. no data is available in the PEU digital data FIFO during the first and last minor frames of each 8 second format. The 78 minor frames are organized as three blocks of 650 words as follows (representing one scan of the instrument):

36 spare words

540 words of Earth view pixel data
(90 x (5 channels + shaft position at mid-pixel))

26 words of housekeeping data

48 words of space view and target view data
(2 x 4 x (5 channels + shaft position))

This structure is maintained for all modes. In static modes, all pixel data locations contain the pixel data for the current antenna position.

The AMSU-B digital format is synchronized to the 8 second synchronization pulse. During each minor frame, 25 words of data are available in the PEU O/P FIFO within 16.7 milliseconds of the start of the minor frame (except in frames 1 and 80). Table 4.1.4.3-1 shows the AMSU-B digital A data format.

Word Length: 16 bits

Serial Output: 25 - 16 bit words per 100 sec (MSB first)

Table 4.1.4.3-1. AMSU-B Digital "A" Data Format for NOAA KLM.

Word Number	**Minor Frame**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
01		SP1	SP26	17/03	18/07	19/11	20/15	P/20	16/24	17/28
02		SP2	SP27	18/03	19/07	20/11	P/16	16/20	17/24	18/28
03		SP3	SP28	19/03	20/07	P/12	16/16	17/20	18/24	19/28
04		SP4	SP29	20/03	P/08	16/12	17/16	18/20	19/24	20/28
05		SP5	SP30	P/04	16/08	17/12	18/16	19/20	20/24	P/29
06		SP6	SP31	16/04	17/08	18/12	19/16	20/20	P/25	16/29
07		P7	SP32	17/04	18/08	19/12	20/16	P/21	16/25	17/29
08		SP8	SP33	18/04	19/08	20/12	P/17	16/21	17/25	18/29
09		SP9	SP34	19/04	20/08	P/13	16/17	17/21	18/25	19/29
10		SP10	SP35	20/04	P/09	16/13	17/17	18/21	19/25	20/29
11		SP11	SP36	P/05	16/09	17/13	18/17	19/21	20/25	P/30
12	Blank	SP12	P/01	16/05	17/09	18/13	19/17	20/21	P/26	16/30
13		SP13	16/01	17/05	18/09	19/13	20/17	P/22	16/26	17/30
14		SP14	17/01	18/05	19/09	20/13	P/18	16/22	17/26	18/30
15		SP15	18/01	19/05	20/09	P/14	16/18	17/22	18/26	19/30
16		SP16	19/01	20/05	P/10	16/14	17/18	18/22	19/26	20/30
17		SP17	20/01	P/06	16/10	17/14	18/18	19/22	20/26	P/31
18		SP18	P/02	16/06	17/10	18/14	19/18	20/22	P/27	16/31
19		SP19	16/02	17/06	18/10	19/14	20/18	P/23	16/27	17/31
20		SP20	17/02	18/06	19/10	20/14	P/19	16/23	17/27	18/31
21		SP21	18/02	19/06	20/10	P/15	16/19	17/23	18/27	19/31
22		SP22	19/02	20/06	P/11	16/15	17/19	18/23	19/27	20/31
23		SP23	20/02	P/07	16/11	17/15	18/19	19/23	20/27	P/32

24		SP24	P/03	16/07	17/11	18/15	19/19	20/23	P/28	16/32
25		SP25	16/03	17/07	18/11	19/15	20/19	P/24	16/28	17/32
Word	**Minor Frame**									
Number	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
01	18/32	9/36	20/40	P/45	16/49	17/53	18/57	19/61	20/65	P/70
02	19/32	20/36	P/41	16/45	17/49	18/53	19/57	20/61	P/66	16/70
03	20/32	P/37	16/41	17/45	18/49	19/53	20/57	P/62	16/66	17/70
04	P/33	16/37	17/41	18/45	19/49	20/53	P/58	16/62	17/66	18/70
05	16/33	17/37	18/41	19/45	20/49	P/54	16/58	17/62	18/66	19/70
06	17/33	18/37	19/41	20/45	P/50	16/54	17/58	18/62	19/66	20/70
07	18/33	19/37	20/41	P/46	16/50	17/54	18/58	19/62	20/66	P/71
08	19/33	20/37	P/42	16/46	17/50	18/54	19/58	20/62	P/67	16/71
09	20/33	P/38	16/42	17/46	18/50	19/54	20/58	P/63	16/67	17/71
10	P/34	16/38	17/42	18/46	19/50	20/54	P/59	16/63	17/67	18/71
11	16/34	17/38	18/42	19/46	20/50	P/55	16/59	17/63	18/67	19/71
12	17/34	18/38	19/42	20/46	P/51	16/55	17/59	18/63	19/67	20/71
13	18/34	19/38	20/42	P/47	16/51	17/55	18/59	19/63	20/67	P/72
14	19/34	0/38	/43	16/47	17/51	8/55	19/59	20/63	P/68	16/72
15	20/34	P/39	16/43	17/47	18/51	19/55	20/59	P/64	16/68	17/72
16	P/35	16/39	17/43	18/47	19/51	20/55	P/60	16/64	17/68	18/72
17	16/35	17/39	18/43	19/47	20/51	P/56	16/60	17/64	18/68	19/72
18	17/35	18/39	19/43	20/47	P/52	16/56	17/60	18/64	19/68	20/72
19	18/35	19/39	20/43	P/48	16/52	17/56	18/60	19/64	20/68	P/73
20	19/35	20/39	P/44	16/48	17/52	18/56	19/60	20/64	P/69	16/73
21	20/35	P/40	16/44	17/48	18/52	19/56	20/60	P/65	16/69	17/73
22	/36	16/40	17/44	18/48	19/52	20/56	P/61	16/65	17/69	18/73
23	16/36	17/40	18/44	19/48	20/52	P/57	16/61	17/65	18/69	19/73
24	17/36	18/40	19/44	20/48	P/53	16/57	17/61	18/65	19/69	20/73
25	18/36	19/40	20/44	P/49	16/53	17/57	18/61	19/65	20/69	P/74
Word	**Minor Frame**									
Number	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
01	16/74	17/78	18/82	19/86	20/90	A25	20/S4	SP1	TST09	17/03
02	17/74	18/78	19/82	20/86	A01	A26	P/T1	SP2	TST10	18/03
03	18/74	19/78	20/82	P/87	A02	P/S1	16/T1	SP3	TST11	19/03
04	19/74	20/78	P/83	16/87	A03	16/S1	17/T1	SP4	TST12	20/03
05	20/74	P/79	16/83	17/87	A04	17/S1	18/T1	SP5	TST13	P/04
06	P/75	16/79	17/83	18/87	A05	18/S1	19/T1	SP6	TST14	16/04
07	16/75	17/79	18/83	19/87	A06	19/S1	20/T1	SP7	TST15	17/04
08	17/75	18/79	19/83	20/87	A07	20/S1	P/T2	SP8	TST16	18/04
09	18/75	19/79	20/83	P/88	A08	P/S2	16/T2	SP9	TST17	19/04
10	19/75	20/79	P/84	16/88	A09	16/S2	17/T2	SP10	TST18	20/04
11	20/75	P/80	16/84	17/88	A10	17/S2	18/T2	SP11	TST19	P/05
12	P/76	16/80	17/84	18/88	A11	18/S2	19/T2	SP12	P/01	16/05

13	16/76	17/80	18/84	19/88	A12	19/S2	20/T2	SP13	16/01	17/05
14	17/76	18/80	19/84	20/88	A13	20/S2	P/T3	SP14	17/01	18/05
15	18/76	19/80	20/84	P/89	A14	P/S3	16/T3	SP15	18/01	19/05
16	19/76	20/80	P/85	16/89	A15	16/S3	17/T3	SP16	19/01	20/05
17	20/76	P/81	16/85	17/89	A16	17/S3	18/T3	SP17	20/01	P/06
18	P/77	16/81	17/85	18/89	A17	18/S3	19/T3	TST01	P/02	16/06
19	16/77	17/81	18/85	19/89	A18	19/S3	20/T3	TST02	16/02	17/06
20	17/77	18/81	19/85	20/89	A19	20/S3	P/T4	TST03	17/02	18/06
21	18/77	19/81	20/85	P/90	A20	P/S4	16/T4	TST04	18/02	19/06
22	19/77	20/81	P/86	16/90	A21	16/S4	17/T4	TST05	19/02	20/06
23	20/77	P/82	16/86	17/90	A22	17/S4	18/T4	TST06	20/02	P/07
24	P/78	16/82	17/86	18/90	A23	18/S4	19/T4	TST07	P/03	16/07
25	16/78	17/82	18/86	19/90	A24	19/S4	20/T4	TST08	16/03	17/07
Word	**Minor Frame**									
Number	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
01	18/07	19/11	20/15	P/20	16/24	17/28	18/32	19/36	20/40	P/45
02	19/07	20/11	P/16	16/20	17/24	18/28	19/32	20/36	P/41	16/45
03	20/07	P/12	16/16	17/20	18/24	19/28	20/32	P/37	16/41	17/45
04	P/08	16/12	17/16	18/20	19/24	20/28	P/33	16/37	17/41	18/45
05	16/08	17/12	18/16	19/20	20/24	P/29	16/33	17/37	18/41	19/45
06	17/08	18/12	19/16	20/20	P/25	16/29	17/33	18/37	19/41	20/45
07	8/08	19/12	20/16	P/21	16/25	17/29	18/33	19/37	20/41	P/46
08	19/08	20/12	P/17	16/21	17/25	18/29	19/33	20/37	P/42	16/46
09	20/08	P/13	16/17	17/21	18/25	19/29	20/33	P/38	16/42	17/46
10	P/09	16/13	17/17	18/21	19/25	20/29	P/34	16/38	17/42	18/46
11	16/09	17/13	18/17	19/21	20/25	P/30	16/34	17/38	18/42	19/46
12	17/09	18/13	19/17	20/21	P/26	16/30	17/34	18/38	19/42	20/46
13	18/09	19/13	20/17	P/22	16/26	17/30	18/34	19/38	20/42	P/47
14	19/09	20/13	P/18	16/22	17/26	18/30	19/34	20/38	P/43	16/47
15	20/09	P/14	16/18	17/22	18/26	19/30	20/34	P/39	16/43	17/47
16	P/10	16/14	17/18	18/22	19/26	20/30	P/35	16/39	17/43	18/47
17	16/10	17/14	18/18	19/22	20/26	P/31	16/35	17/39	18/43	19/47
18	17/10	18/14	19/18	20/22	P/27	16/31	17/35	18/39	19/43	20/47
19	18/10	19/14	20/18	P/23	16/27	17/31	18/35	19/39	20/43	P/48
20	19/10	20/14	P/19	16/23	17/27	18/31	19/35	20/39	P/44	16/48
21	20/10	P/15	16/19	17/23	18/27	19/31	20/35	P/40	16/44	17/48
22	P/11	16/15	17/19	18/23	19/27	20/31	P/36	16/40	17/44	18/48
23	16/11	17/15	18/19	19/23	20/27	P/32	16/36	17/40	18/44	19/48
24	17/11	18/15	19/19	20/23	P/28	16/32	17/36	18/40	19/44	20/48
25	18/11	19/15	20/19	P/24	16/28	17/32	18/36	19/40	20/44	P/49
Word	**Minor Frame**									
Number	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
1	16/49	17/53	18/57	19/61	20/65	P/70	16/74	17/78	18/82	19/86

02	17/49	18/53	19/57	20/61	P/66	16/70	17/74	18/78	19/82	20/86
03	18/49	19/53	20/57	P/62	16/66	17/70	18/74	19/78	20/82	P/87
04	19/49	20/53	P/58	16/62	17/66	18/70	19/74	20/78	P/83	16/87
05	20/49	P/54	16/58	17/62	18/66	19/70	20/74	P/79	16/83	17/87
06	P/50	16/54	17/58	18/62	19/66	20/70	P/75	16/79	17/83	18/87
07	16/50	17/54	18/58	19/62	20/66	P/71	16/75	17/79	18/83	19/87
08	17/50	18/54	19/58	20/62	P/67	16/71	17/75	18/79	19/83	20/87
09	18/50	19/54	20/58	P/63	16/67	17/71	18/75	19/79	20/83	P/88
10	19/50	20/54	P/59	16/63	17/67	18/71	19/75	20/79	P/84	16/88
11	20/50	P/55	16/59	17/63	18/67	19/71	20/75	P/80	16/84	17/88
12	P/51	16/55	17/59	18/63	19/67	20/71	P/76	16/80	17/84	18/88
13	16/51	17/55	18/59	19/63	20/67	P/72	16/76	17/80	18/84	19/88
14	17/51	18/55	19/59	20/63	P/68	16/72	17/76	18/80	19/84	20/88
15	18/51	19/55	20/59	P/64	16/68	17/72	18/76	19/80	20/84	P/89
16	19/51	20/55	P/60	16/64	17/68	18/72	19/76	20/80	P/85	16/89
17	20/51	P/56	16/60	17/64	18/68	19/72	20/76	P/81	16/85	17/89
18	P/52	16/56	17/60	18/64	19/68	20/72	P/77	16/81	17/85	18/89
19	16/52	17/56	18/60	19/64	20/68	P/73	16/77	17/81	18/85	19/89
20	17/52	18/56	19/60	20/64	P/69	16/73	17/77	18/81	19/85	20/89
21	18/52	19/56	20/60	P/65	16/69	17/73	18/77	19/81	20/85	P/90
22	19/52	20/56	P/61	16/65	17/69	18/73	19/77	20/81	P/86	16/90
23	20/52	P/57	16/61	17/65	18/69	19/73	20/77	P/82	16/86	17/90
24	P/53	16/57	17/61	18/65	19/69	20/73	P/78	16/82	17/86	18/90
25	16/53	17/57	18/61	19/65	20/69	P/74	16/78	17/82	18/86	19/90
Word	**Minor Frame**									
Number	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
01	20/90	A25	20/S4	SP1	TST09	17/03	18/07	19/11	20/15	P/20
02	A01	A26	P/T1	SP2	TST10	18/03	19/07	20/11	P/16	16/20
03	A02	P/S1	16/T1	SP3	TST11	19/03	20/07	P/12	16/16	17/20
04	A03	16/S1	17/T1	SP4	TST12	20/03	P/08	16/12	17/16	18/20
05	A04	17/S1	18/T1	SP5	TST13	P/04	16/08	17/12	18/16	19/20
06	A05	18/S1	19/T1	SP6	TST14	16/04	17/08	18/12	19/16	20/20
07	A06	19/S1	20/T1	SP7	TST15	17/04	18/08	19/12	20/16	P/21
08	A07	20/S1	P/T2	SP8	TST16	18/04	19/08	20/12	P/17	16/21
09	A08	P/S2	16/T2	SP9	TST17	19/04	20/08	P/13	16/17	17/21
10	A09	16/S2	17/T2	SP10	TST18	20/04	P/09	16/13	17/17	18/21
11	A10	17/S2	18/T2	SP11	TST19	P/05	16/09	17/13	18/17	19/21
12	A11	18/S2	19/T2	SP12	P/01	16/05	17/09	18/13	19/17	20/21
13	A12	19/S2	20/T2	SP13	16/01	17/05	18/09	19/13	20/17	P/22
14	A13	20/S2	P/T3	SP14	17/01	18/05	19/09	20/13	P/18	16/22
15	A14	P/S3	16/T3	SP15	18/01	19/05	20/09	P/14	16/18	17/22
16	A15	16/S3	17/T3	SP16	19/01	20/05	P/10	16/14	17/18	18/22
17	A16	17/S3	18/T3	SP17	20/01	P/06	16/10	17/14	18/18	19/22

18	A17	18/S3	19/T3	TST01	P/02	16/06	17/10	18/14	19/18	20/22
19	A18	19/S3	20/T3	TST02	16/02	17/06	18/10	19/14	20/18	P/23
20	A19	20/S3	P/T4	TST03	17/02	18/06	19/10	20/14	P/19	16/23
21	A20	P/S4	16/T4	TST04	18/02	19/06	20/10	P/15	16/19	17/23
22	A21	16/S4	17/T4	TST05	19/02	20/06	P/11	16/15	17/19	18/23
23	A22	17/S4	18/T4	TST06	20/02	P/07	16/11	17/15	18/19	19/23
24	A23	18/S4	19/T4	TST07	P/03	16/07	17/11	18/15	19/19	20/23
25	A24	19/S4	20/T4	TST08	16/03	17/07	18/11	19/15	20/19	P/24
Word	**Minor Frame**									
Number	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
01	16/24	17/28	18/32	19/36	20/40	P/45	16/49	17/53	18/57	19/61
02	17/24	18/28	19/32	20/36	P/41	16/45	17/49	18/53	19/57	20/61
03	18/24	19/28	20/32	P/37	16/41	17/45	18/49	19/53	20/57	P/62
04	19/24	20/28	P/33	16/37	17/41	18/45	19/49	20/53	P/58	16/62
05	20/24	P/29	16/33	17/37	18/41	19/45	20/49	P/54	16/58	17/62
06	P/25	16/29	17/33	18/37	19/41	20/45	P/50	16/54	17/58	18/62
07	16/25	17/29	18/33	19/37	20/41	P/46	16/50	17/54	18/58	19/62
08	17/25	18/29	19/33	20/37	P/42	16/46	17/50	18/54	19/58	20/62
09	18/25	19/29	20/33	P/38	16/42	17/46	18/50	19/54	20/58	P/63
10	19/25	20/29	P/34	16/38	17/42	18/46	19/50	20/54	P/59	16/63
11	20/25	P/30	16/34	17/38	18/42	19/46	20/50	P/55	16/59	17/63
12	P/26	16/30	17/34	18/38	19/42	20/46	P/51	16/55	17/59	18/63
13	16/26	17/30	18/34	19/38	20/42	P/47	16/51	17/55	18/59	19/63
14	17/26	18/30	19/34	20/38	P/43	16/47	17/51	18/55	19/59	20/63
15	18/26	19/30	20/34	P/39	16/43	17/47	18/51	19/55	20/59	P/64
16	19/26	20/30	P/35	16/39	17/43	18/47	19/51	20/55	P/60	16/64
17	20/26	P/31	16/35	17/39	18/43	19/47	20/51	P/56	16/60	17/64
18	P/27	16/31	17/35	18/39	19/43	20/47	P/52	16/56	17/60	18/64
19	16/27	17/31	18/35	19/39	20/43	P/48	16/52	17/56	18/60	19/64
20	17/27	18/31	19/35	20/39	P/44	16/48	17/52	18/56	19/60	20/64
21	18/27	19/31	20/35	P/40	16/44	17/48	18/52	19/56	20/60	P/65
22	19/27	20/31	P/36	16/40	17/44	18/48	19/52	20/56	P/61	16/65
23	20/27	P/32	16/36	17/40	18/44	19/48	20/52	P/57	16/61	17/65
24	P/28	16/32	17/36	18/40	19/44	20/48	P/53	16/57	17/61	18/65
25	16/28	17/32	18/36	19/40	20/44	P/49	16/53	17/57	18/61	19/65
Word	**Minor Frame**									
Number	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
01	20/65	P/70	16/74	17/78	18/82	19/86	20/90	A25	20/S4	Blank
02	P/66	16/70	17/74	18/78	19/82	20/86	A01	A26	P/T1	
03	16/66	17/70	18/74	19/78	20/82	P/87	A02	P/S1	16/T1	
04	17/66	18/70	19/74	20/78	P/83	16/87	A03	16/S1	17/T1	
05	18/66	19/70	20/74	P/79	16/83	17/87	A04	17/S1	18/T1	
06	19/66	20/70	P/75	16/79	17/83	18/87	A05	18/S1	19/T1	

07	20/66	P/71	16/75	17/79	18/83	19/87	A06	19/S1	20/T1
08	P/67	16/71	17/75	18/79	19/83	20/87	A07	20/S1	P/T2
09	16/67	17/71	18/75	19/79	20/83	P/88	A08	P/S2	16/T2
10	17/67	18/71	19/75	20/79	P/84	16/88	A09	16/S2	17/T2
11	18/67	19/71	20/75	P/80	16/84	17/88	A10	17/S2	18/T2
12	19/67	20/71	P/76	16/80	17/84	18/88	A11	18/S2	19/T2
13	20/67	P/72	16/76	17/80	18/84	19/88	A12	19/S2	20/T2
14	P/68	16/72	17/76	18/80	19/84	20/88	A13	20/S2	P/T3
15	6/68	17/72	18/76	19/80	20/84	P/89	A14	P/S3	16/T3
16	17/68	18/72	19/76	20/80	P/85	16/89	A15	16/S3	17/T3
17	18/68	19/72	20/76	P/81	16/85	17/89	A16	17/S3	18/T3
18	19/68	20/72	P/77	16/81	17/85	18/89	A17	18/S3	19/T3
19	20/68	P/73	16/77	17/81	18/85	19/89	A18	19/S3	20/T3
20	P/69	16/73	17/77	18/81	19/85	20/89	A19	20/S3	P/T4
21	16/69	17/73	18/77	19/81	20/85	P/90	A20	P/S4	16/T4
22	17/69	18/73	19/77	20/81	P/86	16/90	A21	16/S4	17/T4
23	18/69	19/73	20/77	P/82	16/86	17/90	A22	17/S4	18/T4
24	19/69	20/73	P/78	16/82	17/86	18/90	A23	18/S4	19/T4
25	20/69	P/74	16/78	17/82	18/86	19/90	A24	19/S4	20/T4

NOTES ON THE PREVIOUS TABLES:

The format consists of minor frames (1 to 80). Minor frames 1 and 80 are blank. This means that no data is available in the PEU output FIFO for reading by the AIP and therefore the AIP should not send any sample pulses to AMSU-B during these minor frame periods.

Table 4.1.4.3-2 indicates the meanings for the variables used in Table 4.1.4.3-1:

Table 4.1.4.3-2. Meaning of Variables in Table 4.1.4.3-1.

Key	Meaning
SP	Spare word (Data is 5555H except for spare words 34 to 36)
TSTxx	Test Data
P/n	Shaft position at mid-integration time for FOV n.
16/n	Integrated output for channel 16 for FOV n.
17/n	Integrated output for channel 17 for FOV n.
18/n	Integrated output for channel 18 for FOV n.
19/n	Integrated output for channel 19 for FOV n.
20/n	Integrated output for channel 20 for FOV n.
/Sn	Space view FOV n.
/Tn	Internal Target view FOV n.
AXX	Multiplexed Housekeeping data.

Table 4.1.3-3. AMSU-B Data Word Description

Digital Sub-multiplexed Channels	
A01	Unit ID + Flags
A02	Digital b Telemetry
A03	Mixer 16 Temperature
A04	Mixer 17 Temperature
A05	Mixer 18/19/20 Temperature
A06	FET Amplifier 16 Temperature
A07	FET Amplifier 17 Temperature
A08	FET Amplifier 18 Temperature
A09	FET Amplifier 19 Temperature
A10	FET Amplifier 20 Temperature
A11	Calibration Target Temperature 1
A12	Calibration Target Temperature 2
A13	Calibration Target Temperature 3
A14	Calibration Target Temperature 4
A15	Calibration Target Temperature 5
A16	Calibration Target Temperature 6
A17	Calibration Target Temperature 7
A18	Sub-reflector Temperature 1
A19	Local Oscillator Monitor Current 16
A20	Local Oscillator Monitor Current 17

A21	Local Oscillator Monitor Current 18/19/20
A22	Local Oscillator 16 Temperature
A23	Local Oscillator 17 Temperature
A24	Local Oscillator 18/19/20 Temperature
A25	PRT Bridge Voltage
A26	PRT Board Temperature
Bit	**A01**
00	Module ID (LSB)
01	Module ID
02	Module ID
03	Module ID
04	Module ID
05	Module ID
06	Module ID
07	Module ID (MSB)
08	Mode Transition Flag
09	Scan Synchronization
10	Pixel Data Invalid Flag
11	Scan Control Status
12	Processor Check Flag
13	Not Defined
14	Not Defined
15 (MSB)	Not Defined
Module Identification (Bits 00 to 07)	
Unit Number	**Identification Number (MSB) (LSB)**
EM	0000 0000
PFM	0000 0100
FM2	0000 1000
FM3	0000 1100
Mode Transition (Bit 08)	
0	Transition complete
1	Transition in progress
Scan Synchronization (Bit 09)	
0	Error <0.1 degrees at 8 second sync pulse
1	Error 0.1 degrees at 8 second sync pulse
Pixel Data Invalid (Bit 10)	
0	Valid
1	Invalid
Scan Control Status (Bit 11)	
0	Running
1	Aborted
Processor Check (Bit 12)	
0	Built-In-Test passed
1	Built-In-Test failed

Bit	A02 (See Note 1)
00 (LSB)	Power On/Off (Relay 1 status)
01	Survival heater On/Off (Relay 2 status)
02	Scan normal mode
03	Parked in target view mode
04	Parked in nadir view mode
05	Parked in space view mode
06	Investigation mode
07	Stepped Mode
08	Channel 16 On/Off (Relay 3 status)
09	Channel 17 On/Off (Relay 4 Status)
10	Channel 18/19/20 On/Off (Relay 5 status)
11	Space View Select (MSB)
12	Space View Select (LSB)
13	Memory checks status
14	ROM check flag
15 (MSB)	RAM check flag
Note: 1. A “1” status indicates “ON” and a “0” (zero) status indicates “OFF.”	

The format structure and definition is identical for all modes. In scanning modes, n, Sn and Tn represent pixel identification. In static modes, n, Sn and Tn have no meaning; all data values relate to the IFOV.

4.1.4.4 MHS for NOAA-N,-N’

The Microwave Humidity Sounder (MHS) instrument replaced the AMSU-B instrument on NOAA-N and -N'. Scientifically, the MHS is very similar to the AMSU-B instrument, but the manner in which the data are output is quite different. The equivalent of "Digital" data on AMSU-B is referred to as "science data telemetry" or just "science data" for the MHS instrument, and comes packaged in a "science data telemetry packet" or "Science Packet" (SCI PKT) for short.

The NOAA-N, N' MHS instrument science data is delayed by two scan lines (or 5 2/3 seconds). The operational Level 1b data accounts for the delay and provides correct geo-location information. The delay, however, is not accounted for in the HRPT broadcast. The two scan line delay is caused by data buffering within the MHS instrument and the spacecraft data handling subsystem.

Consultative Committee for Space Data Systems (CCSDS) is composed of space agencies and industrial associates worldwide, working together to provide well-engineered, standardized solutions for common space data handling needs. The benefits of using CCSDS include: reduced cost, risk and development time, as well as enhanced interoperability and cross-support. For more information on CCSDS, refer to their website at: http://www.ccsds.org/. The data packets for MHS are in CCSDS format (i.e., a primary header, secondary header and checksum).

The MHS instrument and its associated interface unit (the MIU) on the NOAA satellites can operate in a variety of different modes and output several different packets, or formats, of data. There are nine different modes for the MHS (see Table 4.1.4.4-1 for details). In addition, all the MHS output must be funneled through a new processor, the MHS Interface Unit (MIU), which may ignore the MHS data completely and output its own telemetry instead. Depending on what mode the MIU is in, different information will be output. For purposes of this Users Guide, only the modes in which MHS data are output will be documented.

The MHS instrument, and its associated interface unit (the MIU) on the NOAA satellites, can operate in a variety of different modes and output several different packets, or formats, of data. There are nine different modes for the MHS (see Table 4.1.4.4-1 for details). In addition, all the MHS output must be funneled through a new processor, the MHS Interface Unit (MIU), which may ignore the MHS data completely and output its own telemetry instead. Depending on what mode the MIU is in, different information will be output. For purposes of this Users Guide, only the modes in which MHS data are output will be documented.

Table 4.1.4.4-1. MHS modes.

MHS Mode	MHS Output
Power-on	Empty Science Data Packet
Warm-up	Empty Science Data Packet
Standby	Empty Science Data Packet
Scan	Science Data Packet
Fixed View	Science Data Packet
Self-test	Extended Test Data Packet
Safeing	Empty Science Data Packet
Fault	Empty Science Data Packet
Memory Dump	Extended Memory Data Packet

The MHS instrument only interfaces to the MIU box. The MIU interfaces to the rest of the NOAA-N, N spacecraft through the TIROS Command and Control Subsystem (CCS), the TIROS Data Handling Subsystem (DHS) and the TIROS Electrical Power Subsystem (EPS). The EPS portion interfacing to the MIU is the Power Subsystem Electronics (PSE) consisting of the 28 v Bus Main, Pulse Load, and Survival Buses. All power is distributed to the MHS through the MIU. The AMSU Information Processor (AIP), the Cross-Strapping Unit (XSU) and the TIROS Information Processor (TIP) boxes comprise the DHS part, while the Control Interface Unit (CIU) is the CCS interface portion of the MIU unit. All of these boxes utilize legacy bus architecture interfaces to the MIU while the MIU implements a Military Standard (MIL-STD) 1553B redundant interface to the MHS instrument. A single 1553 bus is used for commanding (CMD), housekeeping (HK) telemetry and for science (SCI) data telemetry packets between the MHS and the MIU. However, the MIU, being the bus controller, determines whether the primary or redundant 1553 bus is utilized. Other than the 1553 bus, there is no redundancy in the MIU. The MHS is redundant internally, having both A and B sides to its

electronics. The MIU supplies telemetry (MHS and MIU) to the ground during all operational modes. It also provides MHS survival temperature telemetry to the TIP even when the MHS and MIU are not powered.

The AIP provides a serial data stream from the spacecraft, which may be transmitted to the ground or embedded into other composite data streams. Within the AIP data, information is collected from the TIP, AMSU-A1, AMSU-A2, and the MIU. The TIP controls the basic data frame timing, generating a minor frame every tenth of a second (in Orbit Mode) and repeating the entire sequence every 32 seconds, called a major frame. The AIP is synchronized to the TIP timing using the 32-second major frame synchronization, and the harmonically related one-tenth second (10 Hz) pulse. The AIP itself has an 8-second major frame, which means it repeats its sequence four times during a TIP major frame.

Since the TIP and AIP minor frames are both 10 Hz, they are locked together, using the TIP synch timing. The TIP 32-second major frame pulse synchronizes the AIP. AIP generates its own 8-second timing, but since that period is harmonically related, it will not drift significantly from the 32-second pulse. AIP keeps the data from the AMSU's and MIU synchronized by passing on the timing pulses as appropriate.

The AIP stores the data from all four inputs in serial buffers during one minor frame, and sequences it into the data steam in the subsequent frame. This is mechanized using two sets of alternate buffers. AIP will initiate the data transfer with the 10 Hz sync, followed by the appropriate number of word strobes, 56 in the case of the MIU. The sync serves only to define the start of the transfer. The actual timing of the strobes will differ for each data source, and in the case of the MIU may not even be continuous, but it will always follow the sync.

The MIU provides a total of 80 sets of 56 8-bit words, called minor cycles, each of which will be inserted into an AIP minor frame. A minor cycle counter within the MIU keeps track of the frame sequence, and its content is included in the 56-word data sequence. Because of the double buffer arrangement, the MIU minor cycle count may not agree exactly with the AIP minor frame. However, the 8-second sync pulse will ensure that they are sequencing together uniformly, counting the same 80 frames.

The 56-word count is synchronized using the 10 Hz pulse, so that the first word will be transferred by the strobe following the synch. The data from the MHS is partially synchronized to the TIP timing, but the MIL-STD-1553 interface bus and MHS scanning mechanics prevent an exact match. Therefore, the MIU receives the MHS data packets, and packages them along with housekeeping telemetry, to produce the 56-word AIP data.

The 10 Hz and the 8-second sync pulses are received at the MIU and applied to the software using two discrete interrupts. Although both signals are intended to be continuous over long periods, a change in system clocking may result in a jump in either one, which causes it to be early or late with respect to previous pulse timing. The MIU is expected to resynchronize itself to the new sequence.

All AIP telemetry includes the Telemetry Frame Header data in words 6-7 of every minor frame.

This is the same data and format as in the TIP Telemetry described in Table 4.1.4.4-5. Table 4.1.4.4-2 contains the format of the MIU AIP data for bytes 6-7.

Table 4.1.4.4-2. MIU AIP Bytes 6 and 7.

MIU Minor Cycle	Bytes	Bits	Description/Definition	State	MIU Subsystem
All	6	0-1	RESERVED		TLM
		2-4	Telemetry Mode: Normal (NORM) Fast Dump (FADU) Slow Dump (SLDU) Very Slow Dump (VSDU) Bus Eng Mode (BEM) Undefined (UNDF) Undefined Undefined	000 001 010 011 100 101 110 111	
		5	TIP ENGR Frame Enabled; 1=ENAB, 0=DISABLE	0/1	
		6-7	MIU ID: MIU1 MIU 2 Single MIU	 00 01 11	
	7	0-7	MIU Minor Cycle (Integer)	Hex	TIME

MIU Normal Mode telemetry is included in AIP bytes 48-97. Science Data is organized by minor frame as depicted in Table 4.1.4.4-4.

Table 4.1.4.4-3. AIP Normal Mode Telemetry Data.

MIU Minor Cycle	Data Description	Notes
0	1553B Bus Data / MHS CCSDS Data (PKT 2)	1,3
1-25	25 words MHS CCSDS Data (PKT 2)	1
26	Last 17 words MHS CCSDS Data / 1553B Data	1, 2
27	1553B Bus Data / MHS CCSDS Data (PKT 0)	1, 2,3
28-52	25 words MHS CCSDS Data (PKT 0)	1
53	Last 17 words MHS CCSDS Data / 1553B Data	1, 2
54	1553B Bus Data / MHS CCSDS Data (PKT 1)	1,3
55-79	25 words MHS CCSDS Data (PKT 1)	1

Notes:
1. CCSDS is the Consultative Committee for Space Data Systems
2. 1553B is the military standard for a multiplexed data bus.
3. OBT is On-Board Time, a six-byte time tag associated with each MHS SCI PKT and composed of a 4-byte coarse time (resolution: seconds) and a 2-byte fine time (resolution: 2^{-16} seconds).

Table 4.1.4.4-4 contains the MIU AIP data for bytes 48-97 (the normal telemetry mode).

Table 4.1.4.4-4 MIU AIP Bytes 48-97 (Normal Telemetry Mode).

MIU Minor Cycle	Bytes	Bits	Description	State	MIU Sub-system	Note
0	48-49	0	NIL BUS Trans Enable, 0=Disable	0/1	1553 Bus BCRT	
		1	MISC BUS Trans Enable, 0=Disable	0/1		
		2	HK BUS Trans Enable, 0=Disable	0/1		
		3	SCI BUS Trans Enable, 0=Disable	0/1		
		4	CMD BUS Trans Enable, 0=Disable	0/1		
		5-15	RESERVED			
	50-51	0-15	HK BUS Fail Periods Count	Hex		
	52-53	0-15	HK BUS Error Table Index	Hex		
	54-55	0-15	SCI BUS Fail Periods Count	Hex		
	56-57	0-15	SCI BUS Error Table Index	Hex		
	58-59	0-15	BUS SKIPPED CMD Count	Hex		
	60-61	0-15	BUS CMD Error Table Index	Hex		
	62-63	0-15	MISC BUS Fail Periods Count	Hex		
	64-65	0-15	MISC BUS Error Table Index	Hex		
	66	0-7	WRAP TEST Failure Count	Hex		
	67	0-7	BIT TEST Failure Count	Hex		
	68-69	0-14	RESERVED			
		15	WRAP TEST Pattern Mod Enable, 0=Disable	0/1		
	70-71	0-15	BIT Timeouts Count	Hex		
	72-73	0-15	BIT Timeouts Count	Hex		
	74-75	0-15	BUS RESET Timeouts Count	Hex		
	76-77	0-14	RESERVED			
		15	BUS Overrun Occurred, 0=no; 1=yes	0/1		
	78-79	0-15	Last Cmd During Bus Overrun	Hex		
	80-81	0-12	RESERVED			
		13	LAST BUS USED, Bus A=1; B=0	0/1		
		14	GROUND PREFERRED BUS, Bus A=1; B=0	0/1		
		15	MIU PREFERRED BUS, Bus A=1; B=0	0/1		
	82-83	0-15	BIT ITERATIONS	Hex		
	84-85	0-15	HK BUS REQUEST RETRY LIMIT	Hex		
	86-87	0-15	HK TVW RETRY LIMIT	Hex		
	88-89	0-15	HK RES RETRY LIMIT	Hex		
	90-95	0-47	CCSDS TIME TAG SCI PKT 2, LSB=2^{-16}	Hex	MHS	1

	96-97	0-15	FIRST WORD OF SCI PKT 2			1
1-25	48-97		NEXT 25 WORDS OF SCI PKT 2			1
26	48-81		LAST 17 WORDS of SCI PKT 2			1
	82-83	0	NIL BUS TRNS ENABLED, 0=Disable	0/1		
		1	MISC BUS TRNS ENABLED, 0=Disable	0/1		
		2	HK BUS TRNS ENABLED, 0=Disable	0/1		
		3	SCI BUS TRNS ENABLED, 0=Disable	0/1		
		4	CMD BUS TRNS ENABLED, 0=Disable	0/1		
		5-15	RESERVED			
	84-85	0-15	HK BUS FAILED PERIODS COUNT	Hex		
	86-87	0-15	HK BUS ERROR TABLE INDEX	Hex		
	88-89	0-15	SCI BUS FAILED PERIODS COUNT	Hex		
	90-91	0-15	SCI BUS ERROR TABLE INDEX	Hex		
	92-93	0-15	BUS SKIPPED COMMAND COUNT	Hex		
	94-95	0-15	BUS CMND ERROR TABLE INDEX	Hex		
	96-97	0-15	MISC BUS FAIL PERIODS COUNT	Hex		
27	48-49	0-15	MISC BUS ERROR TABLE INDEX	Hex	Second iteration 1553 Bus BCRT	
	50	0-7	WRAP TEST FAILURE COUNT	Hex		
	51	0-7	BIT TEST FAILURE COUNT	Hex		
	52-53	0-14	RESERVED			
		15	WRAP TEST PATTERN MOD ENABLED, 0=Disable	0/1		
	54-55	0-15	BIT TIMEOUTS CONT	Hex		
	56-57	0-15	BIT RESULTS	Hex		
	58-59	0-15	BUS RESET TIMEOUTS CONT	Hex		
	60-61	0-14	RESERVED			
		15	BUS OVERRUN OCCURRED, 0=no; 1=yes	0/1		
	62-63	0-15	LAST COMMAND During BUS Overrun	Hex		
	64-65	0-12	RESERVED			
		13	LAST BUS USED, Bus A=1; B=0	0/1		
		14	GROUND PREFERRED BUS, Bus A=1; B=0	0/1		
		15	MIU PREFERRED BUS, Bus A=1; B=0	0/1		
	66-67	0-15	RESET ITERATIONS	Hex		
	68-69	0-15	SCI BUS REQUEST RETRY LIMIT	Hex		
	70-71	0-15	SCI TVW RETRY LIMIT	Hex		
	72-73	0-15	SCI RES RETRY LIMIT	Hex		
	74-79	0-47	CCSDS TIMETAG SCI PKT 0, LSB= -16	Hex	MHS	

	80-97		FIRST 9 WORDS OF SCI PKT 0			
28-52	48-97		NEXT 25 WORDS OF SCI PKT 0			
53	48-65		LAST 9 WORDS OF SCI PKT 0			
	66-67	0	NIL BUS TRNS ENABLED, 0=Disable	0/1	Third iteration 1553 Bus BCRT	
		1	MISC BUS TRNS ENABLED, 0=Disable	0/1		
		2	HK BUS TRNS ENABLED, 0=Disable	0/1		
		3	SCI BUS TRNS ENABLED, 0=Disable	0/1		
		4	CMD BUS TRNS ENABLED, 0=Disable	0/1		
		5-15	RESERVED			
	68-69	0-15	HK BUS Failed Periods Count	Hex		
	70-71	0-15	HK BUS Error Table Index	Hex		
	72-73	0-15	SCI BUS Failed Periods Count	Hex		
	74-75	0-15	SCI BUS Error Table Index	Hex		
	76-77	0-15	BUS Skipped Command Count	Hex		
	78-79	0-15	BUS CMD Error Table Index	Hex		
	80-81	0-15	MISC BUS Failed Periods Count	Hex		
	82-83	0-15	MISC BUS Error Table Index	Hex		
	84	0-7	WRAP TEST Failure Count	Hex		
	85	0-7	BIT TEST FAILURE COUNT	Hex		
	86-87	0-14	RESERVED			
		15	WRAP TEST Pattern Mod Enabled, 0=Disable	0/1		
	88-89	0-15	BIT TIMEOUTS COUNT	Hex		
	90-91	0-15	BIT RESULTS	Hex		
	92-93	0-15	BUS RESET Timeouts Count	Hex		
	94-95	0-14	RESERVED			
		15	BUS OVERRUN OCCURRED, 0=no; 1=yes	0/1		
	96-97	0-15	LAST CMD During BUS Overrun	Hex		
54	48-49	0-12	RESERVED			
		13	LAST BUS USED, Bus A=1; B=0	0/1		
		14	GROUND PREFERRED BUS, Bus A=1; B=0	0/1		
		15	MIU PREFERRED BUS, Bus A=1; B=0	0/1		
	50-51	0-15	BCRTM Last INTR LOG List PNTR	Hex		
	52-53	0-15	CMD RETRY LIMIT	Hex		
	54-55	0-15	MISC RETRY LIMIT	Hex		
	56-61	0-47	CCSDS TIMETAG SCI PKT 1, SB=2-16	Hex	MHS	
	62-97		FIRST 18 WORDS OF SCI PKT 1			
55-79	48-97		NEXT 25 WORDS OF SCI PKT 1			

Note:
1. Packet 2 (PKT 2) reports the prior 8-second period (n-1).

Some of the terms used in the above table are explained here. There are five transaction types: NIL, MISC (Miscellaneous), HK (Housekeeping), SCI (Science) and CMD (Command). The NIL cycle is described as a placeholder (No Operation) mode. Its purpose is to kill time until time to perform another operation. MISC cycle outputs test results from WRAP and BIT for the housekeeping and Science RT channels. Housekeeping Cycle sends failed and re-try counters on Housekeeping issues from bytes 48-73. Science Cycle sends various failed and re-try counters on SCI issues from bytes 48-73. Command Cycle sends various failed and re-try counters on CMD issues from bytes 48-73.

Table 4.1.4.4-5 depicts the data sent in bytes 98-101 during AIP Normal Telemetry mode. This data repeats four times per major frame beginning with major and minor cycle counts in minor frames 0, 20, 40 and 60. Telemetry data I/O Reads are sent in bytes 98-99 during minor frames 2, 22, 42 and 62. Some of the key telemetry data from these AIP bytes 98-101 include TIP and AIP First In First Out (FIFO) status, Bus Controller state, CIU State, Uplink queue, CMD VERIF word, Error counts, Memory dump stats, Time and Error Log Indices.

Table 4.1.4.4-5. MIU AIP Telemetry Bytes 98-101 - Normal Telemetry Mode.

MIU Minor Cycle				Byte	Bits	Description	State
0	20	40	60	98-101	0-31	Major Cycle Count: MSW LSW	 Hex Hex
1	21	41	61	98-99	0-15	Minor Cycle Error Count	Hex
				100-101	0-14	RESERVED	
					15	MIU in Sync with Major Cycle: 1=yes, 0=no	0/1
2	22	42	62	98-99	0-15	Results of I/O Read	
				100	0	TIP FIFO was reset; 1=yes, 0=no	0/1
					1	TIP FIFO was full; 1=yes, 0=no	0/1
					2	TIP FIFO was empty; 1=yes, 0=no	0/1
					3	AIP FIFO was reset; 1=yes, 0=no	0/1
					4	AIP FIFO was full; 1=yes, 0=no	0/1
					5	AIP FIFO was empty; 1=yes, 0=no	0/1
					6	Minor Cycle Sync Received; 1=yes, 0=no	0/1
					7	Major Cycle Sync Received; 1=yes, 0=no	0/1
				101	0	FIFO Reset Under S/W Control; 1=yes, 0=no	0/1
					1	Reset AIP FIFO Commanded; 1=yes, 0=no	0/1
					2	Reset TIP FIFO Commanded; 1=yes, 0=no	0/1

					3	TIP FIFO Data inverted; 1=yes, 0=no	0/1
					4	AIP FIFO Data inverted; 1=yes, 0=no	0/1
					5	TIP FIFO Enabled; 1=yes, 0=no	0/1
					6	AIP FIFO Enabled; 1=yes, 0=no	0/1
					7	INT Reset Under S/W Control; 1=yes, 0=no	0/1
3	23	43	63	98-99	0-13	Reserved	
					14-	BUS Controller State: Off Enabling On Disabling	 00 01 10 11
				100-101	0-13	Reserved	
					14-	Bus Controller MODE: TLM HK Dump SCI Dump Undefined	 00 01 10 11
4	24	44	64	98-99	0-14	Reserved	
					15	Housekeeping Bus Process: 0=TLM; 1=Dump	0/1
				100-101	0-14	Reserved	
					15	Science Bus Processing Mode: 0=TLM; 1=DUMP	0/1
5	25	45	65	98-99	0-15	BC Unexplained Exceptions CNT	Hex
				100-101	0-15	MHS CMD Queue Count	Hex
6	26	46	66	98	0-1	CIU ISR STATE: Waiting for next CMD Collecting CMD hdr Collecting CMD hdr Collecting datawords	 00 01 10 11
					2	Uplink Queue is full; 0=no, 1=yes	0/1
					3	Uplink Queue was reset; 0=no, 1=yes	0/1
					4-7	Reserved	
				99	0-7	Number of data words transferred (8 bits)	Hex
				100-101	0-15	CMD Verification Word	Hex
7	27	47	67	98-99	0-15	Exception Occurred Count	Hex
				100-101	0-15	Unhandled Interrupt Count	Hex
8	28	48	68	98-99	0-14	Reserved	
					15	Memory Scrub Enabled; 0=no, 1=yes	0/1
				100-101	0-15	Single Bit Error Count	Hex
9	29	49	69	98-101	0-31	Last Ram Address Scrubbed: MSW LSW	 Hex Hex

10	30	50	70	98-99	0-15	Machine Error Count	Hex
				100-101	0-14	Reserved	
					15	Stuck Bit Detected; 0=yes, 1=no	0/1
11	31	41	71		0-31	Address of Stuck Bit: MSW LSW	 Hex Hex
12	32	52	72	98-99	0-14	Reserved	
					15	Memory Checksum Enabled; 0=yes, 1=no	0/1
				100-101	0-15	Memory Checksum Error Count	Hex
13	33	53	73	98-101	0-31	Ram Dump Start Address: MSW LSW	 Hex Hex
14	34	54	74	98-101	0-31	HK Bus Memory Dump Start Address: MSW LSW	 Hex Hex
15	35	55	75	98-101	0-31	SCI Bus Memory Dump Start Address: MSW LSW	 Hex Hex
16	36	56	76	98-101	0-31	Ram Dump Requested Word Count: MSW LSW	 Hex Hex
17	37	57	77	98-99	0-15	HK Dump Requested Word Count	Hex
				100-101	0-15	SCI Dump Requested Word Count	Hex
18	38	58	78	98-99	0-15	Main Cycle Count	Hex
				100-101	0-15	Minor Frame Reception Tolerance	Hex
19	39	59	79	98-99	0-15	Exception Log Save Index	Hex
				100-101	0-15	Interrupt Log Save Index	Hex

TIROS Information Processor (TIP) telemetry from the MIU is supplied as 8-bits in Byte 102 of each TIP minor frame (this corresponds to AIP minor frame byte 205). The content of an MHS telemetry packet is essentially a subset of the science data packet. It contains telemetry data, except not as much as is found in a science data packet, but no science data (i.e., no views of earth and the warm and cold targets). The format of the MIU TIP Telemetry Frame (normal) is given in Table 4.1.4.4-6.

Table 4.1.4.4-6. MIU TIP Telemetry Frame - Normal.

TIP Minor Frame Count	Bits	Description/Definition	State	MIU Subsystem	Notes
1	0-1	Reserved			
	2-4	Telemetry Mode: Normal Fast Dump	 000 001	TLM	

		Slow Dump Very Slow Dump Bus Engr Mode Undefined Undefined Undefined	010 011 100 101 110 111		
	5	TIP Engineering Frame Enabled; 0=Disabled	0/1		2
	6-7	MIU ID: MIU 1 MIU 2 Single MIU	 00 01 11	MIU H/W	
2	0-7	MIU Minor Cycle Number (Integer)	Hex	Time	
3-4	0-15	Command Verification Word (Refer to CV Word Definition)	Hex	CMD	
5-6	0-13	Reserved			
	14-15	BUS Controller Mode: TLM HK Dump SCI Dump Undefined	 00 01 10 11	BUS Control	
7-10	0-31	Scan Period 2 Coarse Time; LSB=1 second	Sec	MHS HK	1
11-12	0-15	Scan Period 2 Fine Time; LSB-216 seconds	Sec		1
13-28	0-127	Scan Period 2 Housekeeping Packet, 16 bytes HK/packet			1
29-30	0-15	Command Verification Word	Hex	CMD	
31-32	0-15	HK Failed Collection Count (Integer)	Hex	BUS	
33-36	0-31	Scan Period 0 Whole Time, LSB=1 sec	Sec	MHS HK	
37-38	0-15	Scan Period 0 Fractional Time; LSB-216 seconds	Sec		
39-54	0-127	Scan Period 0 Housekeeping Packet; 16 bytes HK/packet			
55-56	0-15	Command Verification Word	Hex	CMD	
57-58	0-15	HK Valid Packets Count	Hex	BUS	
59-62	0-31	Scan Period 2 Whole Time; LSB=1 second	Sec	MHS HK	
63-64	0-15	Scan Period 1 Fractional Time; LSB-216 seconds	Sec		
65-79, 0	0-128	Scan Period 1 Housekeeping Packet; 16 bytes HK/packet			

Notes:
1. Scan Period 2 is reporting prior 8-second frame (n-1).
2. When TIP ENGR Frame is enabled, disregard MIU 1 indications of Normal in this mode.

Table 4.1.4.4-7 lists the telemetry packet types that are generated on the Science Data Bus:

Table 4.1.4.4-7. Science Data Bus telemetry packet types.	
Packet Type	**Total Packet Length (octets)**
Science Data Packet	1300
Extended Memory Data Packet (EMDP)	1042
Extended Test Data Packet (ETDP)	1300

The Packets are in Consultative Committee for Space Data Systems (CCSDS) format (i.e., a primary header, secondary header and checksum). The detailed structure of the Source Data field is given in the following sections.

Table 4.1.4.4-8 shows the fields that the Science Data Packets contain.

Table 4.1.4.4-8. Science Data Packet Fields.	
Field Name	**Size (Octets)**
Full Housekeeping Data	39
Status Word	1
Signal Processing Status	9
Pixel Data	1176
OBCT Temperature Data	16
Spares	45

The format of the Full Housekeeping Data field is described at the end of this section.
In modes which do not generate Science Data (i.e. all modes except Scan Mode and Fixed View Mode), an Empty Science Data Packet is generated, in which the remaining fields of the Science Data Packet are undefined.

The format of the spares field is unallocated at present. All octets will be set to “00".
Table 4.1.4.4-9 shows the format of the Status Word.

Table 4.1.4.4-9. Format of the Status Word Field.							
MSB							**LSB**
DC Offset Valid	Scan Control Valid	Profile		Unused			

The DC Offset Valid bit is set to a 1" when all channels calibration targets readings lie within acceptable limits, as determined by the DC Offset Algorithm. This bit will be set only in Scan Mode when the calibration targets are sampled.

The Scan Control Valid bit is set to a 1" if all mid-pixel positions of the reflector during Earth, Space and On-Board Calibration Target (OBCT) views are within the limits for the Scan Mode

profile, or within the limits of the requested position in Fixed View Mode. This bit will be set only in Scan Mode or Fixed View Mode.

The Profile code is set to:
00 : Profile 0
01 : Profile 1
10 : Profile 2
11 : No Profile calculated (profile will be manually loaded/modified)

It is intended that Profile 0 will define the Nominal Scan Mode Profile with nominal Space View position. Profiles 1 and 2 will nominally be used for the alternate Space view positions. However, any profile can be reprogrammed to another position versus time profile by reloading the Scan Control Table profile parameters.

The format of the Signal Processing Status field is shown in Table 4.1.4.4-10.

Table 4.1.4.4-10. Format of Signal Processing Status Field.

MSB							**LSB**
Channel H1 DC Offset Word							
Channel H2 DC Offset Word							
Channel H3 DC Offset Word							
Channel H4 DC Offset Word							
Channel H5 DC Offset Word							
H1 VALID	H2 VALID	H3 VALID	H4 VALID	H5 VALID	SPE MUX CODE		
H1 GAIN			H2 GAIN		UNUSED		
H3 GAIN			H4 GAIN		UNUSED		
H5 GAIN			UNUSED		UNUSED		

The Valid bit is set to a “1" when all samples of this channel for this scan revolution lie within the ADC dynamic range. H1..H5 are the five input channels from the Receiver. The Electronics Equipment (EE) has six signal processing channels, SPE1..SPE6. In the nominal configuration, the Receiver channel is connected to the corresponding EE channel, e.g., H1 to SPE1, and SPE6 is unused.

The SPE Mux Code is used to identify which Receiver channel, if any, is connected to the EE redundant channel, as shown in Table 4.1.4.4-11.

Table 4.1.4.4-11. SPE MUX Code Subfield format.

SPE MUX Code	**Configuration**
000	H1 to SPE 6
001	H2 to SPE 6
010	H3 to SPE 6
011	SPE 6 not used
100	H4 to SPE 6
101	H5 to SPE6

110	SPE6 not used
111	SPE6 not used

The H1...H5 Gain Fields identify the gain settings of the Receiver video output channels as in Table 4.1.4.4-12.

Table 4.1.4.4-12. Receiver Gains Sub Field.	
Gain Code	**Gain**
000	0 dB
001	1 dB
010	2 dB
011	3 dB
1xx	not used

The Science Data field can be separated into Earth, Space and OBCT View Data fields, which all follow a common format. They are differentiated only by the source of the data that is written to them. The fields are arranged as shown in Table 4.1.4.4-13.

Table 4.1.4.4-13. Science Data Field Format.	
Field name	**Number of Pixel subfields**
Earth	90
Space	4
OBCT	4

In Fixed View Mode, the Science Data Packet is the same format as Scan Mode, but the concept of Earth, Space and OBCT pixels does not apply. All 98 pixels are for the fixed view position. The (90 + 4 + 4) pixels are however collected with the same timing as though Scan Mode were performed.

Each of the Pixel sub-fields contain a position and five pixel values. The format of a Pixel Subfield is shown in Table 4.1.4.4-14.

Table 4.1.4.4-14. Pixel Subfield Format.							
MSB							**LSB**
Mid-pixel Position MS Byte							
Mid-pixel Position LS Byte							
Channel H1 Data MS Byte							
Channel H1 Data LS Byte							
Channel H2 Data MS Byte							
Channel H2 Data LS Byte							
Channel H3 Data MS Byte							
Channel H3 Data LS Byte							
Channel H4 Data MS Byte							
Channel H4 Data LS Byte							

Channel H5 Data MS Byte
Channel H5 Data LS Byte

The Mid-pixel position data is the angular position of the Reflector at the mid-point of the pixel integration period defined by.

The OBCT Temperature Data field contains the On-Board Calibration Target high precision temperature parameters. The format of this block is given in Table 4.1.4.4-15.

Table 4.1.4.4-15. OBCT Subfield Format.

MSB							**LSB**
Unused				On-Board Target Temperature 1			
On-Board Target Temperature 1 (PRT1)							
Unused				On-Board Target Temperature 2			
On-Board Target Temperature 2 (PRT 2)							
Unused				On-Board Target Temperature 3			
On-Board Target Temperature 3 (PRT 3)							
Unused					On-Board Target Temperature 4		
On-Board Target Temperature 4 (PRT 4)							
Unused				On-Board Target Temperature 5			
On-Board Target Temperature 5 (PRT 5)							
Unused				Calibration Channel 1			
Calibration Channel 1 (PRT CAL 1: 118 Ω)							
Unused				Calibration Channel 2			
Calibration Channel 2 (PRT CAL 2: 95.3 Ω)							
Unused				Calibration Channel 3			
Calibration Channel 3 (PRT CAL 3: 80.6 Ω)							

The full Housekeeping Telemetry Data blocks contain the following fields as shown in Table 4.1.4.4-16.

Table 4.1.4.4-16. Full Housekeeping Telemetry Data Block.

Field Name	**Size (Octets)**
Mode and Subcommutation Code	1
Telecommand Acknowledgement and Fault Code	5
Switch Status	3
Temperature Data	24
Raw Current Consumption Data	6

The Sub-Commutation code is not significant for the Science Data packet as all telemetry is returned.

As with other packets, the Mode Code identifies the packet as either a Science Data Packet (Scan and Fixed View Modes), an Extended Test Packet (self-test mode), an Extended Memory Data

Packet (Mode Code = “1111") or an Empty Science Data Packet (all other Modes). Note that the Telecommand Acknowledgement field of Science Data packets provides acknowledgement of commands received on the Science Data Bus. (Commands on the Command/telemetry Bus are acknowledged in HK Telemetry Packets.)

The Temperature Data Field of each packet will contain all twenty-four thermistor telemetry channel parameters, instead of the multiplexed four of the Housekeeping telemetry packet. The OBCT temperatures are not contained here, as all such values are allocated a separate field in the Science Data Bus.

The Raw Current Consumption Data Field is the internal PSU Current analog telemetry as defined in Table 4.1.4.4-17.

Table 4.1.4.4-17. Raw Current Consumption Data Field Format.

MSB							**LSB**
+5V Secondary Current							
+8V Receiver Current							
+15V Receiver Current							
-15V Receiver Current							
RDM Motor Current							
FDM Motor Current							

4.1.5 AIP MINOR FRAME FORMATS

The spacecraft’s AMSU Instrument Processor (AIP) collects digital data from the AMSU-A and AMSU-B sensors. This data consists of earth view pixel data, housekeeping data and space and blackbody view data.

4.1.5.1 AIP Minor Frame Format for NOAA KLM

Figure 4.1.5.1-1 shows the AIP telemetry word location in the frame format, and Table 4.1.5.1-1 contains AIP telemetry word titles, locations within the frame, and word descriptions in tabular form.

Figure 4.1.5.1-1. AIP Output Format for NOAA KLM.

0 1 2 22-bit sync	3 ///	4 MFC	5 1)	6 7 ///	8 20 |----------AMSU-A1 (Words 8 through 33)---------->
21 33 <----------AMSU-A1----------|					34 40 |----------AMSU-A2 (Words 34 through 47)--->
41					48

47 <----------AMSU-A2----------						60 	----------AMSU-B (Words 48 through 97)---------->							
61 80 <--- ----------AMSU-B---------->														
81 97 <----------AMSU-B----------												98 ///	100	
101 ///	102 2)	103 105 20-bit sync SC ID		106 1), 3)	107 3), 4)	108 4)	109 110 CMMD VER	111 5)	112 114 Analog subcom 32/16/1 seconds	115 5)	116 6)	117 DAU-1	118 DAU-2	119 HIRS/3	120 HIRS/3
121 122 DCS-2		123 124 SEM	125 126 HIRS/3		127 128 DCS-2		129 130 HIRS/3	131 132 DCS-2	133 134 HIRS/3	135 136 DCS-2		137 138 HIRS/3		139 140 SBUV/2	
141 142 HIRS/3		143 144 DCS-2	145 146 HIRS/3		147 148 DCS-2		149 154 |<----------CPU-A Telemetry---------->			155 156 DCS-2		157 158 HIRS/3		159 160 DCS-2	
161 162 HIRS/3/		163 164 DCS-2	165 166 HIRS/3		167 168 HIRS/3		169 170 HIRS/3	171 172 DCS-2	173 174 HIRS/3	175 176 DCS-2		177 178 HIRS/3		179 180 DCS-2	
181 182 HIRS/3		183 184 SBUV/2	185 186 HIRS/3		187 188 HIRS/3		189 190 DCS-2	191 192 HIRS/3	193 194 DCS-2	195 196 HIRS/3		197 198 DCS-2		199 200 |-----CPU-B >	

201 204 < Telemetry------ -------|	205 ///	206 207 7)	

NOTES: /// indicates spare bits and reads 010101, etc.
1) Words 5 and 106: Bit 1-Command Verification Status, Bits 2 & 3- TIP status, Bits 4, 5 & 6- Major Frame Counter
2) Word 102: Bits 1 & 2 spare, followed by 6 bits AMSU parity
3) Words 106 and 107: 9 Bit Dwell address
4) Words 107 and 108: 9 Bit Subcommutation counter
5) Digital-B Subcommutation (32 second)
6) Analog Subcommutation
7) Word 206: 2 bits CPU data status followed by 6 bits TIP parity; word 207: 2 bits spare followed by 6 bits TIP parity calculated by AIP

Table 4.1.5.1-1. AIP Minor Frame Format for NOAA KLM.

Function	**No. of Words**	**Word Position**	**Bit No. 1 2 3 4 5 6 7 8 Plus Word Code & Meaning**
Frame Sync	3	0	1 1 1 1 0 0 1 1 Frame sync is first 22 bits. Last 2 bits of word 2 are: 00
		1	0 1 1 0 1 0 1 1
		2	0 0 0 0 0 0 0 0
Spare	1	3	0 1 0 1 0 1 0 1
Minor Frame Counter	1	4	0 0 0 0 0 0 0 0 Represents minor frame 0
			0 1 0 0 1 1 1 1 Represents minor frame 79
			MSB is first.
Major frame Counter	1	5	First six bits are 000000. Last 2 bits are major (8 sec) frame counter. The major frame counter is incremented every 80 minor frames. Bits 7 and 8 of minor frame 5 will count 8-second intervals, the count overflowing to 0 synchronous with the TIP 32-second major frame pulse.
Spare	2	6	0 1 0 1 0 1 0 1
		7	0 1 0 1 0 1 0 1
AMSU-A1	26	8 thru 33	8 Bit words are formed by the AMSU-A1 experiment and are read out by the AMSU Information Processor at an average rate of 260 words per second.
AMSU-A2	14	34 thru 47	8 Bit words are formed by the AMSU-A2 experiment and are read out by the AMSU Information Processor at an average rate of 140 words per second.
AMSU-B	50	48 thru 97	8 Bit words are formed by the AMSU-B experiment and are read out by the AMSU Information Processor at an average rate of 500 words per second.
Spare	4	98 thru 101	0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 . . . . .
AMSU Parity	1	102	Bit 1: 0

			Bit 2: 1
			Bit 3: Even parity check words 2 thru 18
			Bit 4: Even parity check words 19 thru 35
			Bit 5: Even parity check words 36 thru 52
			Bit 6: Even parity check words 53 thru 69
			Bit 7: Even parity check words 70 thru 86
			Bit 8: Even parity check words 87 thru Bit 7 of word 102
TIP Data	104	103 thru 206	Identical to TIP minor frame format in Table 4.3.3.1-1.
TIP Parity	1	207	Bit 1: 0
			Bit 2: 1
			Bit 3: Even parity check words 105 thru 121
			Bit 4: Even parity check words 122 thru 138
			Bit 5: Even parity check words 139 thru 155
			Bit 6: Even parity check words 156 thru 172
			Bit 7: Even parity check words 173 thru 189
			Bit 8: Even parity check words 190 thru Bit 7 of word 206
			This parity word amounts to an AIP recalculation of the TIP parity which was calculated by the TIP in TIP word 103 (AIP word 206).

4.1.5.2 AIP Minor Frame Format for NOAA-N,-N'

Figure 4.1.5.2-1 and Table 4.1.5.2-1 contain AIP telemetry word titles, locations within the frame, and word descriptions in tabular form for NOAA-N,-N'.

0 1 2 22 BIT SYNC	3	4 MAJOR FRAME COUNT	5 SEE NOTE	6 7 MIU/MHS STATUS	8 AMSU-A1 (WORDS 8 THROUGH 33)	23
24 AMSU-A1	33	34 AMSU-A2 (WORDS 34 THOUGH 47)	47			
48 MHS (WORDS 48 THOUGH 101)	71					
72 MHS (WORDS 48 THOUGH 101)	95					

96 97 MHS	98 99 100 101 MHS Status Words	102 See Note	103 See Note	104 See Note	105 See Note	106 See Note	107 See Note	108 See Note	109 110 Command Verification	111 DIG B 3.2 SEC	112 ANA SUB 32 SEC	113 ANA SUB 16 SEC	114 ANA SUB 1 SEC	115 DIG B SUB	116 ANA SUB 2	117 DAU 1	118 DAU 2	119 HIRS/4
120 HIRS 4	121 122 DCS-2	123 124 SEM	125 126 HIRS/4	127 128 DCS-2	129 130 HIRS/4	131 132 DCS-2	133 134 HIRS/4	135 136 DCS-2	137 138 HIRS/4	139 140 SBUV/2	141 142 HIRS/4	143 DCS 2						
144 DCS 2	145 146 HIRS/4	147 148 DCS-2	149 CPU A TELEMETRY	154	155 156 DCS-2	157 158 HIRS/4	159 160 DCS-2	161 162 HIRS/4	163 164 DCS-2	165 166 HIRS/4	167 DCS 2							
168 DCS 2	169 170 HIRS/4	171 172 DCS-2	173 174 HIRS/4	175 176 DCS-2	177 178 HIRS/4	179 180 DCS-2	181 182 HIRS/4	183 184 SBUV/2	185 186 HIRS/4	187 188 HIRS/4	189 190 DCS-2	191 HIRS 4						
192 HIRS 4	193 194 DCS-2	195 196 HIRS/4	197 198 DCS-2	199 CPU B TELEMETRY	204	205 MIU	206 See Note	207 See Note										

Notes:
Number in upper line indicates minor frame word number
Frame sync is first 22 bits, the last two bits of word 2 are: 00
/// Word locations are spare and contain code 01010101
First six bits of word 6 are 000000. Last two bits are 8-second frame counter
Words 103 through 206 are identical to a TIP orbital mode minor frame words 0 through 103
Minor frame period= 0.1 sec
Output data rate =16.54 kbps

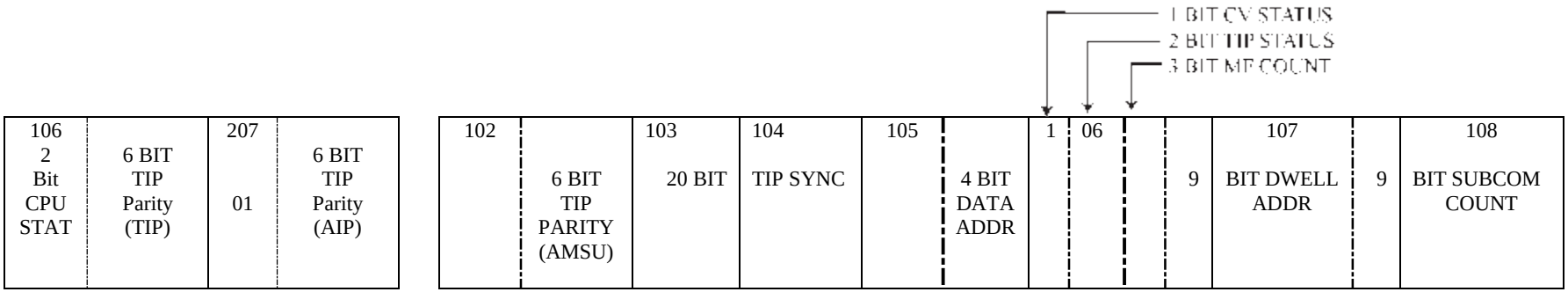


Figure 4.1.5.2-1. AIP Output Format for NOAA-N, N'

Table 4.1.5.2-1. AIP Minor Frame Format for NOAA-N, -N'.				
Function	**No. of Words**	**Word Position**	**Bit No. 1 2 3 4 5 6 7 8 plus word code and meaning**	**Notes**
22-bit Frame Sync	3	0-2	22-bit Frame Sync	1
Spare	1	3	0 1 0 1 0 1 0 1	
Minor Frame Counter	1	4	0 0 0 0 0 0 0 0 represents Minor Frame 0; 0 1 0 0 1 1 1 1 represents Minor Frame 79; MSB is first.	2
8 Second Frame Counter	1	5	First six bits are 0 0 0 0 0 0. Last two bits are major (8-sec) frame counter. The major frame counter is incremented every 80 minor frames. Bits 7 and 8 of minor frame 5 will count 8-second intervals, the count overflowing to 0 synchronous with the TIP 32-second major frame pulse.	
MIU/MHS Status	2	6 7	8-bit words formed by the MIU to record status of the MHS and the MIU and read by the AMSU Information Processor at an average rate of 20 words per second.	
AMSU-A1	26	8 thru 33	8-bit words are formed by the AMSU-A1 experiment and are read out by the AMSU Information Processor (AIP) at an average rate of 260 words per second.	
AMSU-A2	14	34 thru 47	8-bit words are formed by the AMSU-A2 experiment and are read out by the AIP at an average rate of 140 words per second.	
MHS	50	48 thru 97	8-bit words are formed by the MHS experiment and are read out by the AIP through the MHS Interface Unit at an average rate of 540 words per second.	
	4	98 thru 101	MIU/MHS Status Words	
6-bit TIP Parity (AMSU)	1	102	Bit 1: 0	
			Bit 2: 1	
			Bits 3-8: 6-bit TIP Parity (AMSU)	
20-bit TIP sync	2-	103 104 105	Bits 1-8: 20-bit TIP sync Bits 1-8 Bits 1-4	4
4-bit DATA ADDR	1-	105	Bits 5-8: 4-bit Data Address	4
Status Bits	1-	106	Bit 1: 1-bit CV Status Bits 2-3: 2-bit TIP Status	4

			Bits 4-6: 3-bit MF Count	
9-bit Dwell ADDR	1+	106 107	Bits 7-8: 9-bit Dwell Address Bits 1-7	4
9-bit SUBCOM COUNT	1+	107 108	Bit 8: 9-bit SUBCOM Count Bits 1-8	4
CV	2	109-110	Command Verification	4
DIG B SUBCOM	1	111	Digital B SUBCOM (3.2 sec)	4
ANALOG SUBCOM	1	112	Analog SUBCOM (32 sec)	4
ANALOG SUBCOM	1	113	Analog SUBCOM (16 sec)	4
ANALOG SUBCOM	1	114	Analog SUBCOM (1 sec)	4
DIG B SUBCOM2	1	115	Digital B SUBCOM2 (3.2 sec)	4
ANALOG SUBCOM2	1	116	Analog SUBCOM2 (16 sec)	4
DAU1	1	117	Decryption Authentication Unit 1	4
DAU2	1	118	Decryption Authentication Unit 2	4
HIRS/4	2	119-120	HIRS/4	4
DCS-2	2	121-122	DCS-2	4
SEM	2	123-124	SEM	4
HIRS/4	2	125-126	HIRS/4	4
DCS-2	2	127-128	DCS-2	4
HIRS/4	2	129-130	HIRS/4	4
DCS-2	2	131-132	DCS-2	4
HIRS/4	2	133-134	HIRS/4	4
DCS-2	2	135-136	DCS-2	4
HIRS/4	2	137-138	HIRS/4	4
SBUV/2	2	139-140	SBUV/2	4
HIRS/4	2	141-142	HIRS/4	4
DCS-2	2	143-144	DCS-2	4
HIRS/4	2	145-146	HIRS/4	4
DCS-2	2	147-148	DCS-2	4
CPU A Telemetry	2	149-154	CPU A Telemetry	4
DCS-2	2	155-156	DCS-2	4
HIRS/4	2	157-158	HIRS/4	4
DCS-2	2	159-160	DCS-2	4
HIRS/4	2	161-162	HIRS/4	4
DCS-2	2	163-164	DCS-2	4
HIRS/4	2	165-166	HIRS/4	4
DCS-2	2	167-168	DCS-2	4
HIRS/4	2	169-170	HIRS/4	4

DCS-2	2	171-172	DCS-2	4
HIRS/4	2	173-174	HIRS/4	4
DCS-2	2	175-176	DCS-2	4
HIRS/4	2	177-178	HIRS/4	4
DCS-2	2	179-180	DCS-2	4
HIRS/4	2	181-182	HIRS/4	4
SBUV	2	183-184	SBUV	4
HIRS/4	2	185-186	HIRS/4	4
HIRS/4	2	187-188	HIRS/4	4
DCS-2	2	189-190	DCS-2	4
HIRS/4	2	191-192	HIRS/4	4
DCS-2	2	193-194	DCS-2	4
HIRS/4	2	195-196	HIRS/4	4
DCS-2	2	197-198	DCS-2	4
CPU B TELEMETRY	6	199-204	CPU B Telemetry	4
MIU	1	205	Bits 1-8: MIU	4
2-bit CPU STAT	1-	206	Bits 1-2: 2-bit CPU Status	4
6-bit TIP Parity (TIP)	1-	206	Bits 3-8: 6-bit TIP Parity (TIP)	4
6-bit TIP Parity (AIP)	1	207	Bit 1: 0 Bit 2: 1 Bits 3-8: 6-bit TIP Parity (AIP)	

NOTES:
1. Frame sync is first 22 bits, last two bits of word 2 are: 0 0.
2. Minor Frame Period = 0.1 sec
3. Output Data Rate = 16.64 kbps
4. Words 103 through 206 are identical to a TIP Orbital Mode Minor Frame's words 0 through 103.

4.2 APT SYSTEM

4.2.1 GENERAL

The Automatic Picture Transmission (APT) system provides a reduced resolution data stream from the AVHRR/3 instrument. Any two of the AVHRR channels can be chosen by ground command for processing and ultimate output to the APT transmitter. A visible channel is used to provide visible APT imagery during daylight, and one IR channel is used constantly (day and night). A second IR channel can be scheduled to replace the visible channel during the nighttime portion of the orbit. The analog APT signal is transmitted continuously and can be received in real time by relatively unsophisticated, inexpensive ground station equipment (a list of equipment manufacturers is available on the NOAASIS Internet site. See Internet resources in Appendix E) while the satellite is within radio range. The characteristics of the transmitted signal remain unchanged in the NOAA KLM and NOAA-N,-N' satellite series from those in the TIROS-N series

(NOAA-8 through NOAA-14), while there is a minor change in the data format to account for the modified channel 3 on the AVHRR instrument.

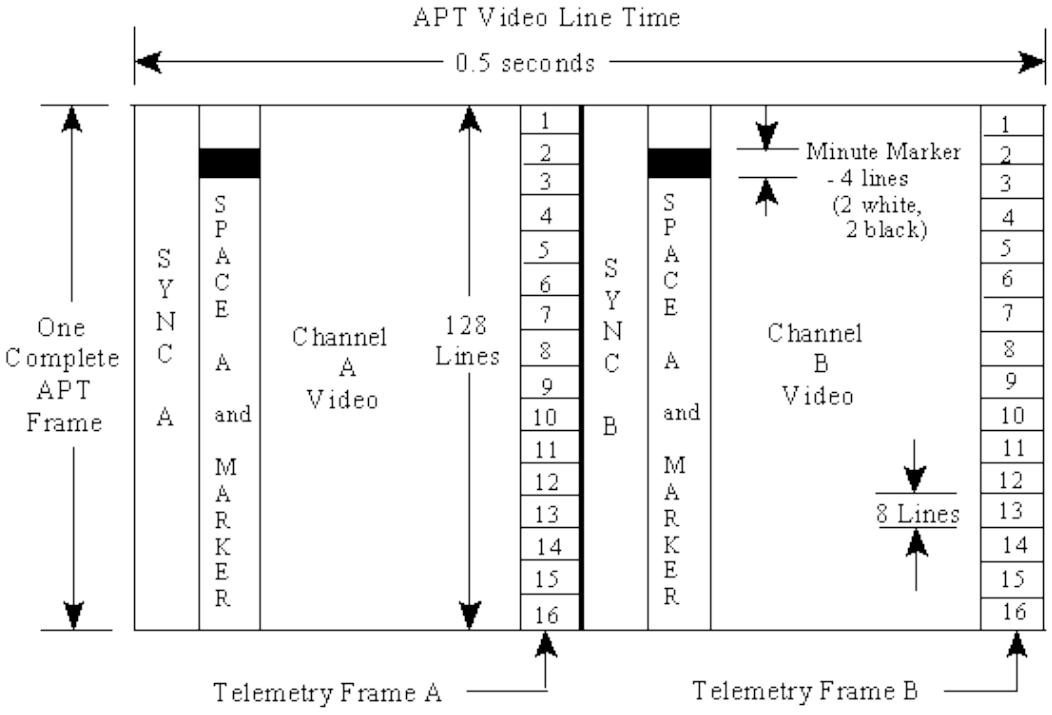
4.2.2 APT TRANSMISSION CHARACTERISTICS

The processed AVHRR instrument data AM modulates a 2400 Hz subcarrier. The maximum subcarrier modulation is defined as the amplitude of the gray scale wedge number 8 (see Figure 4.2.2-1), producing a modulation index of 87% $\pm$ 5% (not exceeding 92%). The AM modulated subcarrier is subsequently used to FM modulate the VTX transmitter operating in the 137 - 138 MHz band. Table 4.2.2-1 summarizes the pertinent APT transmission characteristics.

Table 4.2.2-1. APT Transmission Characteristics.

Line Rate	120 lines/min
Data Channels	2 transmitted 6 available
Data Resolution	4.0 km
Carrier Modulation	2.4 KHz AM subcarrier on FM carrier
Transmitter Frequency (MHz)	137.50 or 137.62
Transmitter Power (EOL)	5 W (37dBm)
Radiated Power (dBm, @ 63 degrees)	36.7
Polarization	RCP

Figure 4.2.2-1. APT Frame Format.



WEDGE #1	WEDGE #2	WEDGE #3	WEDGE #4	WEDGE #5	WEDGE #6	WEDGE #7	WEDGE #8
1	2	3	4	5	6	7	8
Zero Modulation Reference	Thermistor Temp. #1	Thermistor Temp. #2	Thermistor Temp. #3	Thermistor Temp. #4	Patch Temp.	Back Scan	Channel I.D. Wedge
9	10	11	12	13	14	15	16

Notes:
1) Each telemetry frames consists of 16 points
2) Telemetry frame rate is 1 frame per 84 seconds
3) Each telemetry point is repeated on 8 successive APT video lines

Figure 4.2.2-1. APT Frame Format

4.2.3 APT Data Frame Format

The MIRP processes the AVHRR data and outputs the APT format (simultaneously with the HRPT, LAC and GAC formats). All the processing in the MIRP is done in the digital realm. The digitized AVHRR input consists of 10-bit words. The MIRP inserts calibration and telemetry data for each of the selected APT channels being transmitted, and AM modulates the 2400 Hz subcarrier, corresponding to the light and dark areas seen by the instrument, with the 8 Most Significant Bits (MSB) of the 10-bit data. The formatted data passes through the MIRP digital-to-analog converter, is filtered and modulated onto the 2400 Hz carrier.

On the NOAA KLM and NOAA-N,N' series, two of the six possible AVHRR spectral channels are multiplexed so that channel A APT data is obtained from one spectral channel of the first AVHRR scan line, and channel B from another spectral channel contained in the second AVHRR scan line. The third AVHRR scan line is omitted from the APT, and the process is repeated. It can be seen that the data processing algorithm is designed so that data from every third line from each of the two selected channels of the original high resolution AVHRR output are formatted for each of the two APT channels. The algorithm also maintains nearly equal geometric resolution of 4 km along the scan line. This is accomplished by using a separate resolution reduction in each of five regions or zones either side of the nadir. The details of this algorithm are shown Table 4.2.3-1 and Figure 4.2.3-1. The two AVHRR channels used are identified in the daily TBUS message, and are further classified by the daytime and nighttime portion of the orbit. Channel identification is also included as part of the telemetry frame.

Table 4.2.3-2 enumerates the APT format parameters. Figures 4.2.2-1, 4.2.3-2 and 4.2.3-3 illustrate the APT frame format, the video line format and signal synchronization details. Examining the frame format shown in Figure 4.2.2-1, it can be seen that both channel A and B have a series of 16 "wedges" used in calibrating the APT image. Each of the wedges is composed of 8 successive video lines. Only the wedges of one frame from an entire, received pass, are needed for calibration. Also note that wedges 1 through 14 are identical on the images from both channels A and B. Only wedges 15 (the back scan value when one of the IR radiometers "looks" at a blackbody radiator) and 16 (channel identification) vary between channel A and B.

The channel identification wedge has changed in the NOAA KLM and NOAA-N,-N' series now that there are six possible channels 1, 2, 3A, 3B, 4 and 5. The modulation index of wedge 16 will equal one of the first six grey scale wedges. Wedge 3 will correspond to channel 3A being in use, while wedge 6 will correspond to channel 3B being in use. All other channel numbers will be the same as the number of the corresponding grey scale wedge.

Table 4.2.3-1 APT Linearization Algorithm

Zone 1 0-16.98 degrees from nadir	Average 4 contiguous samples	628 AVHRR data samples per channel	157 processed APT words output to D/A converter
Zone 2 16.98-34.83 degrees	Average 3 contiguous samples, skip 1,	330 AVHRR data samples per channel	110 processed APT words output to D/A

either side of nadir	repeat		converter
Zone 3 34.83-43.83 degrees either side of nadir	Average 2 contiguous samples	166 AVHRR data samples per channel	83 processed APT words to output D/A converter
Zone 4 43.83-48.84 degrees either side of nadir	Average 1.5 samples (A+B/2 and B+C/2)	93 AVHRR data samples per channel	62 processed APT words output to D/A converter
Zone 5 48.84-55.4 degrees either side of nadir	Retain original resolution	121 AVHRR data samples per channel	121 processed APT words output to D/A converter.

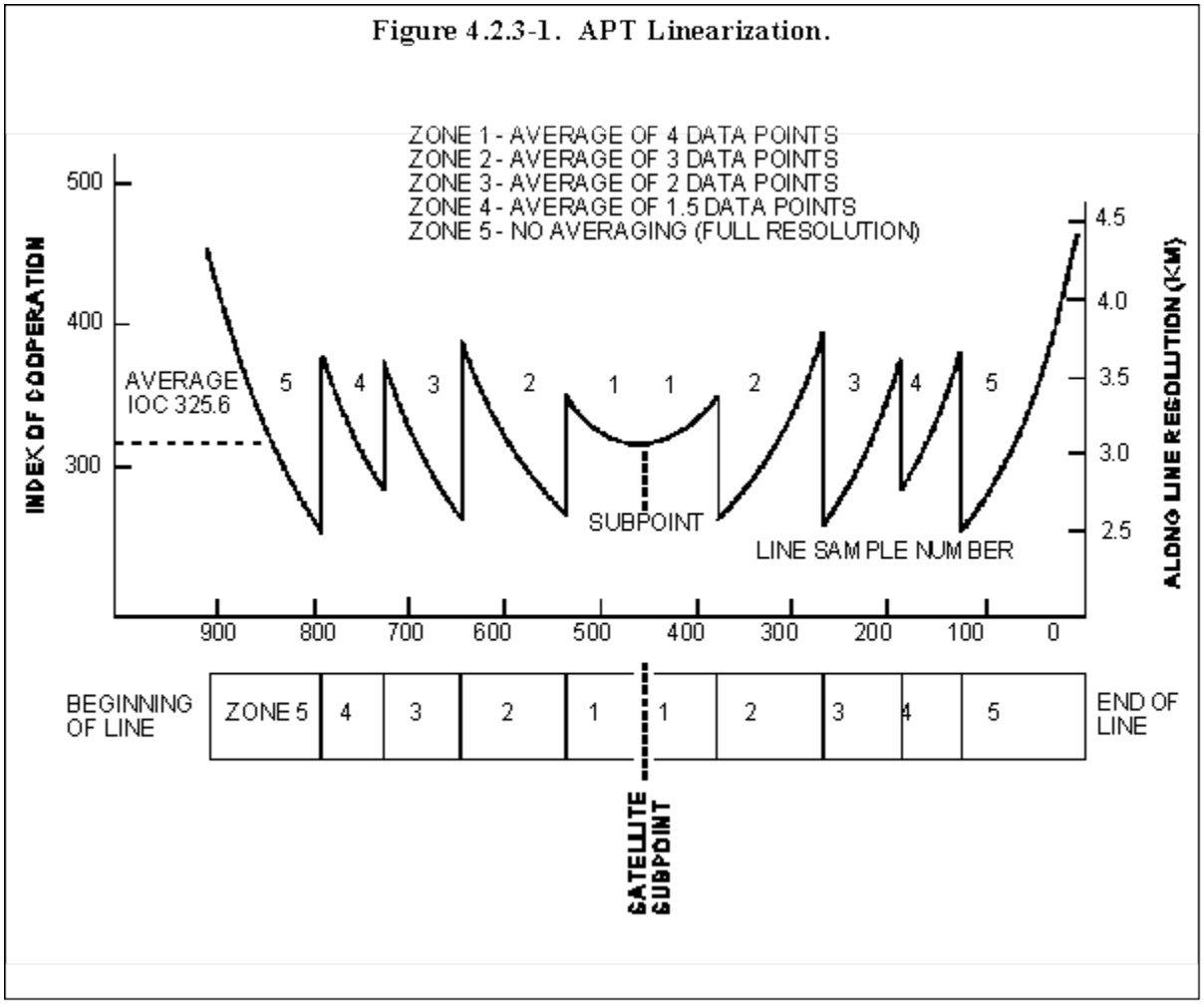


Figure 4.2.3-1. APT Linearization

Table 4.2.3-2. APT Parameters	
Frame	
Rate	1 frame/64 sec
Length	128 lines
Format	See Table 4.2.3-1

Line Parameters	
Rate	2 lines/sec
Number of words	2080
Number of sensor channels	2
Number of words/sensor channel	909
Format	See Figure 4.2.3-1
Line sync format	See Figures 4.2.3-2 and4.2.3-3
Word Parameters	
Rate	4160 words/sec
D/A conversion accuracy	8 MSB's each 10 bit word

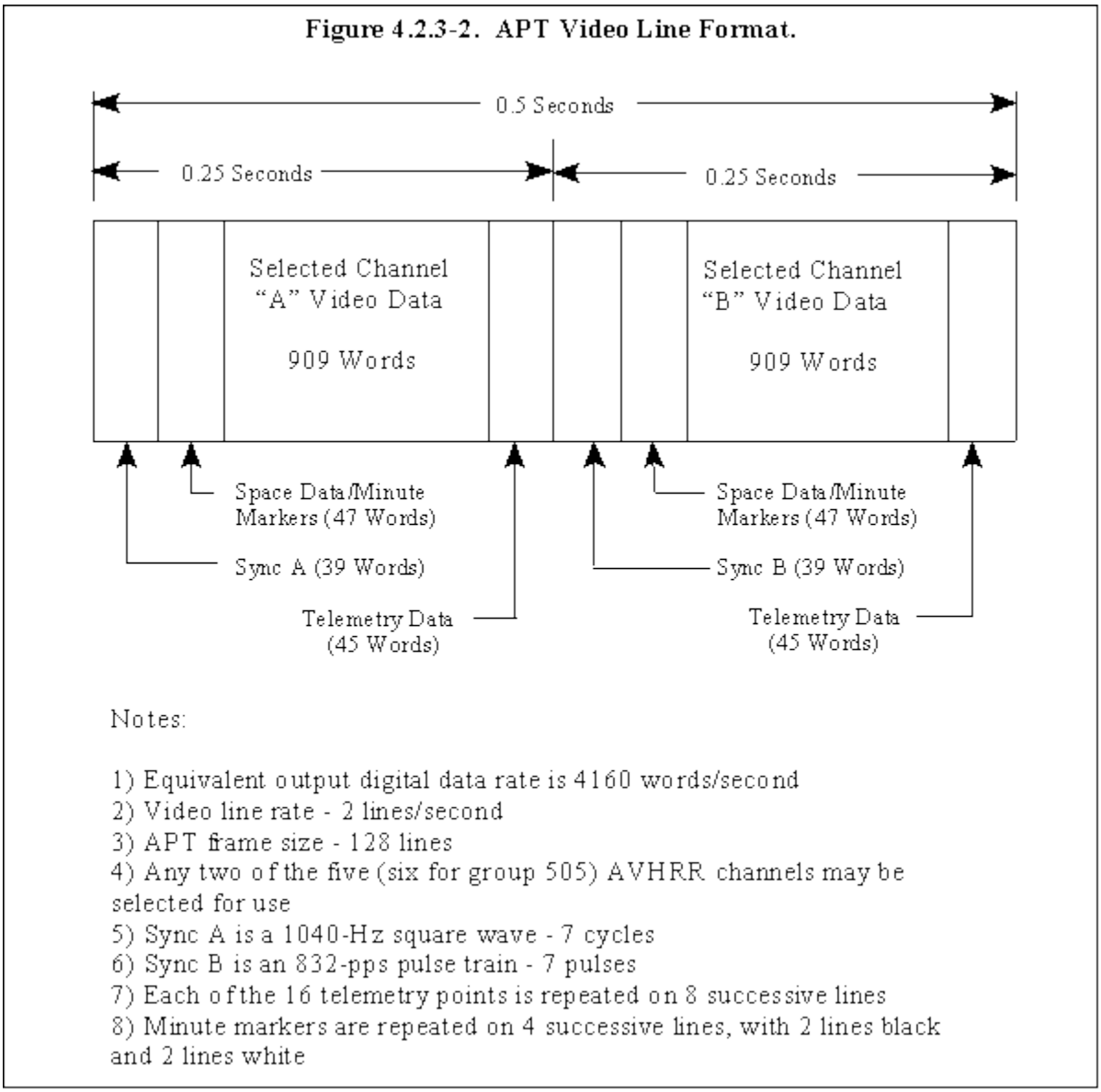


Figure 4.2.3-2. APT Video Line Format

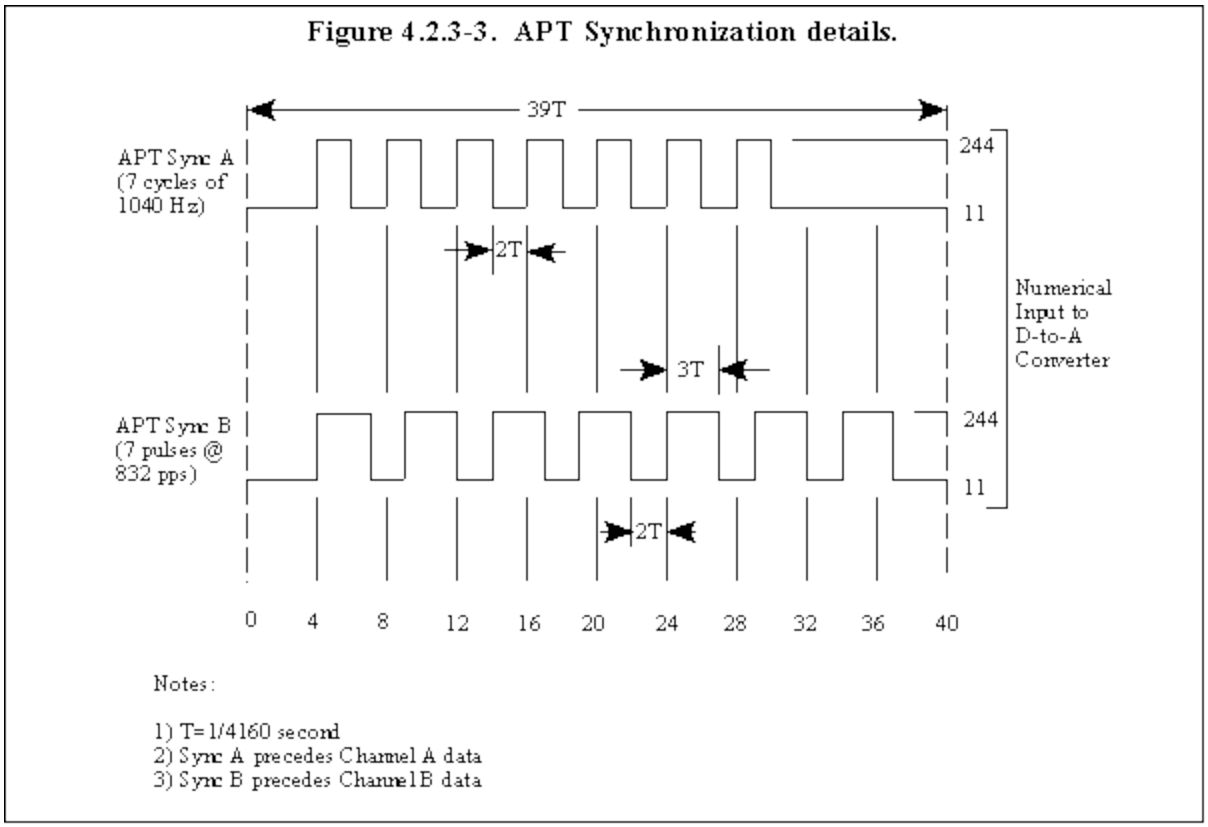


Figure 4.2.3-3. APT Synchronization Details

4.3 DIRECT SOUNDER BROADCAST (DSB)

4.3.1 GENERAL

The Direct Sounder Broadcast (DSB, also referred to as the beacon transmission) contains the low bit rate instrument (HIRS/3, HIRS/4 on NOAA-N, -N', SBUV/2, SEM, and DCS/2, but not AMSU) digital data, identical to that within the HRPT transmission. Data are therefore available in both the VHF and S-band links. Those users receiving the high resolution HRPT transmission would likely find it most desirable to extract the low rate data from this data stream. The VHF beacon transmission is available to users who do not intend to install the more complex equipment necessary to receive high data rate S-band service. The lower data rates permit the user to install less complex, less costly equipment to receive the data without degrading its quality.

4.3.2 DSB Transmission Characteristics

On board the satellite, output from the low data rate instruments is collected and formatted by the TIROS Information Processor (TIP). Parallel outputs are provided for the real-time VHF beacon transmission (DSB) and the MIRP (for the HRPT service). The instrument data is multiplexed with analog and digital housekeeping data. The TIP output directly modulates the beacon transmission. The data is transmitted as an 8.32 Kbps split phase signal (similar to the HRPT

transmission, above) over one of the beacon transmitters (BTX). Detailed transmission characteristics and TIP parameters are shown in Tables 4.3.2-1 and 4.3.2-2.

Table 4.3.2-1 DSB Transmission Characteristics	
Carrier Modulation	Digital split phase, phase modulated
Transmitter Frequency (Mhz)	137.35 or 137.77
Transmitter Power (EOL)	1.0 watts (30dBm)
Radiated Power (dBm)	.5 (over 90% of sphere)
Polarization	RCP

Table 4.3.2-2 TIP Parameters	
Major Frame	
Rate Minor Frames/Major Frame	1 major frame/32 sec 320
Minor Frame	
Rate Number of words Format	10 minor frames/sec 11090 See Table 4.3.2-3
Word Parameters	
Rate Number of bits/word Order	1040 words/sec 8 Bit 1=MSB Bit 8=LSB
Bit Parameters	
Rate Format Data "0" Data "1"	8320 Bits/sec Split phase -67/+67degrees +67/-67degrees

4.3.3 TIP FRAME FORMAT

The TIP format is based on a major frame which contains 320 minor frames.

4.3.3.1 TIP Minor Frame Format for NOAA-KLM

About one-quarter of the 104 telemetry word locations in the TIP minor frame have been changed for NOAA KLM. This is due to the removal of the Stratospheric Sounding Unit (SSU) and Earth Radiation Budget Experiment (ERBE) from the new series of spacecraft. Word locations previously assigned to the SSU have been allocated to the HIRS/3 and Data Collection System (DCS). The ERBE word locations have been reassigned to DCS, as well. In addition, two words have been allocated to the Decryption Authentication Unit (DAU). Table 4.3.3.1-1 shows the TIP telemetry word location in the frame format. Table 4.3.3.1-2 contains telemetry word titles, locations within the frame, and word descriptions in tabular form

.

Table 4.3.3.1-1. TIP Minor Frame Format for NOAA KLM.

0 1 2 | 4-BIT - - - - - - 20-BIT SYNCH - - - -| S/C 11101101 1110001 0000 | ID			3 4 5 STATUS, DWELL MODE ADDRESS, MINOR FRAME COUNTER			6 7 CMD VERIFICATION DATA		8 DIG-B SUBCOM-1	9 ANALOG SUB COM (32 SEC)	10 ANALOG SUB COM (16 SEC)	11 ANALOG SUB COM (1 SEC)
12 DIG-B SUB COM-2	13 ANALOG SUB COM (16 SEC)	14 DAU-1	15 DAU-2	16 HIRS/3	17 HIRS/3	18 DCS-2	19 DCS-2	20 SEM	21 SEM	22 HIRS/3	23 HIRS/3
24 DCS-2	25 DCS-2	26 HIRS/3	27 HIRS/3	28 DCS-2	29 DCS-2	30 HIRS/3	31 HIRS/3	32 DCS-2	33 DCS-2	34 HIRS/3	35 HIRS/3
36 SBUV/2	37 SBUV/2	38 HIRS/3	39 HIRS/3	40 DCS-2	41 DCS-2	42 HIRS/3	43 HIRS/3	44 DCS-2	45 DCS-2	46 47 CPU-A TELEMETRY	
48 49 50 51 - - - - - CPU-A TELEMETRY - - - - - -				52 DCS-2	53 DCS-2	54 HIRS/3	55 HIRS/3	56 DCS-2	57 DCS-2	58 HIRS/3	59 HIRS/3
60 DCS-2	61 DCS-2	62 HIRS/3	63 HIRS/3	64 DCS-2	65 DCS-2	66 HIRS/3	67 HIRS/3	68 DCS-2	69 DCS-2	70 HIRS/3	71 HIRS/3
72 DCS-2	73 DCS-2	74 HIRS/3	75 HIRS/3	76 DCS-2	77 DCS-2	78 HIRS/3	79 HIRS/3	80 SBUV/2	81 SBUV/2	82 HIRS/3	83 HIRS/3
84 HIRS/3	85 HIRS/3	86 DCS-2	87 DCS-2	88 HIRS/3	89 HIRS/3	90 DCS-2	91 DCS-2	92 HIRS/3	93 HIRS/3	94 DCS-2	95 DCS-2
96 97 98 99 100 101 - - - - - - - - - - - - - - - - - CPU-B TELEMETRY - - - - - - - - - - - - - -						102 SPARE 01010101	103 6-BITS EVEN PARITY	MINOR FRAME PERIOD - 0.1 SEC MAJOR FRAME PERIOD - 32 SEC OUTPUT DATA RATE - 8.320 KBPS			

(NUMBER IN UPPER LEFT CORNER INDICATES MINOR FRAME WORD NUMBER)

Table 4.3.3.1-2. TIP Minor Frame Format for NOAA KLM			
Function	**No. of Words**	**Word Position**	**Bit No. 1 2 3 4 5 6 7 8 Plus Word Code & Meaning**
Frame Sync & SC ID	3	0	11101101 (MSB) is first)
		1	11100010
		2	0000AAAA (Last 4 bits are spacecraft ID)
Status	1-	3	Bit 1: CMD verification (cv) status; 1=cv update word present in frame; 0=no cv update id frame Bits 2&3: TIP status; 00=orbital mode;10=CPU Memory Dump Mode;01=Dwell Mode;11=Boost Mode Bits 4-6: Major Frame Count; 000 Major Frame 0; 111=Major Frame 7; MSB first; Counter incremented every 320 minor frames
Dwell Mode Address	1+		Bits 7&8: 9 bit dwell mode address of analog channel that is being monitored continuously
		3	000000000-Analog channel 0
		4	111111111-Analog channel 511
Minor Frame Counter	1+	4	Bit 8, bits 1-8: 000000000=Minor Frame 0
		5	100111111-Minor frame 319
Command Verification	2	6	Bits 9 thru 24 of each valid received or stored command word are placed in the 16 bit slots of telemetry words 6 and 7 on a one-for-one basis.
		7	
Time Code	5	8,9	9 bits of binary Cay Count, MSB first
		9	Bits 2-5: 0101, Spare Bits
		9,10	27 bits of Binary millisec of Day Count, MSB first
		11	Time code is inserted on word location 8-12 only in minor frame 0 of every major frame. The data inserted is referenced to the beginning of the first bit or the minor frame sync word of minor frame 0 within ∀ millisecond.
		12	
Digital "B" Subcom-1	1	8	A Subcommutation of Discrete Inputs collected to form 8 bit words. 256 Discrete Inputs (32 words) can be accommodated. It takes 32 frames to sample all inputs once (sampling rate=once/3.2 sec). A Major Frame contains 10 complete Digital "B" subcommutated frames.
Analog Subcom (32 sec)	1	9	A subcommutation of up to 191 analog points sampled once every 32 seconds plus 64 analog points sampled twice every 32 seconds (once every 16 seconds). Bit 1 of each word represents 2560 mV, while Bit 8 represents 20 mV.

Analog Subcom (16 sec)	1	10	This subcommutation is controlled by a PROM located in the TIP and contains 160 word locations with 128 analog channels sampled once every 16 seconds.
Analog Subcom (1 sec)	1	11	This subcommutation is controlled by a PROM in the TIP and contains 10 analog channels sampled once every 1 second. Word 0 of this subcom is filled with data from an analog point selected by command. The selected analog point may be one of the 512 analog points available to the TIP. Bit on of each word represents 2560 mV while Bit 8 represents 20 mV.
Digital "B" Subcom-2	1	12	The subcommutation of discrete inputs collected to form 8 Bit words. 256 discrete inputs (32 words) can be accommodated. It takes 32 minor frames to sample all inputs once (sampling rate=once/3.2 sec). A Major Frame contains 10 complete Digital "B" subcommutated frames. 64 of these bit locations corresponding to TIP minor frames 24-31 form the XSU Digital "A" data. The XSU generates an 8 word subcom which is read out at the rate of one word per minor frame. The XSU subcom is synchronized with its word 1 in minor frame 24.
Analog Subcom-2 (16 sec)	1	13	This subcommutation is controlled by a PROM located in the TIP and contains 160 words locations with 128 analog channels sampled once every 16 seconds. The remaining 32 word locations contain data from the Solar Array Telemetry Commutator Unit (SATCU). The SATCU receives inputs from16 sources on the solar array, commutates them and presents this stream and presents it in the last 32 word locations. The 32 words represent two successive passes through the SATCU subcom.
DAU-1	1	14	8 Bit Housekeeping Telemetry words are formed by the DAU-1 and read out by the telemetry system at an average of 10 words per second.
DAU-2	1	15	8 Bit Housekeeping Telemetry words are formed by the DAU-2 and read out by the telemetry system at an average of 10 words per second.

HIRS/3	36	16,17, 22,23, 26,27, 30,31, 34,35, 38,39, 42,43, 54,55, 58,59, 62,63, 66,67, 70,71, 74,75, 78,79, 82,83, 84,85, 88,89, 92,93	8 Bit words are formed by the HIRS/3 experiment and are read out by the telemetry system at an average rate of 360 words per second.
SEM	2	20,21	8 Bit words are formed by the SEM sensor and ready out by the telemetry system at an average rate of 20 words per second.
DCS-2	32	18,19, 24,25, 28,29, 32,33, 40,41, 44,45, 52,53, 56,57, 60,61, 64,65, 68,69, 72,73, 76,77, 86,87, 90,91, 94,95	8 Bit words are formed by the DCS experiment and are read out by the telemetry system at an average rate of 320 words per second
SBUV/2	4	36,37, 80,81	8 Bit words are formed by the SBUV/2 experiment and read out by the telemetry system at an average rate of 40 words per second.
CPU A Telemetry	6	46,47, 48,49, 50,51	A second block of 16 Bit CPU words is ready out by the telemetry system every minor frame.

CPU B Telemetry	6	96,97, 98,99, 100,101	A second block of 16 Bit CPU words is ready out by the telemetry system every minor frame.
CPU Data Status	1-	103	Bits 1 And 2: 00=All CPU data received 01=All CPU A data received; CPU B data incomplete 10= All CPU B data received; CPU A data incomplete 11=CPU A and CPU B data incomplete
Parity	1-	103	Bit 3: Even parity check in words 2 through 18 Bit 4: Even parity check in words 19 thru 35 Bit 5: Even parity check in words 36 thru 52 Bit 6: Even parity check in words 53 thru 69 Bit 7: Even parity check in words 70 thru 86 Bit 8: Even parity check in words 87 thru bit 7 of word 103

4.3.3.2 TIP Minor Frame Format for NOAA-N, -N'

For NOAA-N, -N', Table 4.3.3.2-1 shows the TIP telemetry word location in the frame format. Table 4.3.3.2-2 shows the TIP telemetry word location in the frame format. Other than HIRS/4 data in place of HIRS/3 data, the only real difference between a NOAA KLM TIP minor frame and a NOAA-N, -N' TIP minor frame is byte 102, which contains MIU data.

Table 4.3.3.2-1. TIP Minor Frame Format for NOAA-N, N'.

0 1 2 | 4-BIT - - - - - - 20-BIT SYNCH - - - -| S/C 11101101 1110001 0000 | ID			**3 4 5 STATUS, DWELL MODE ADDRESS, MINOR FRAME COUNTER** See Note 2			**6 7 CMD VERIFICATION DATA**		**8 DIG-B SUBCOM-1**	**9 ANALOG SUB COM (32 SEC)**	**10 ANALOG SUB COM (16 SEC)**	**11 ANALOG SUB COM (1 SEC)**
12 DIG-B SUB COM-2	**13 ANALOG SUB COM (16 SEC)**	**14 DAU-1**	**15 DAU-2**	**16 HIRS/3**	**17 HIRS/3**	**18 DCS-2**	**19 DCS-2**	**20 SEM**	**21 SEM**	**22 HIRS/4**	**23 HIRS/4**
24 DCS-2	**25 DCS-2**	**26 HIRS/4**	**27 HIRS/4**	**28 DCS-2**	**29 DCS-2**	**30 HIRS/4**	**31 HIRS/4**	**32 DCS-2**	**33 DCS-2**	**34 HIRS/4**	**35 HIRS/4**
36 SBUV/2	**37 SBUV/2**	**38 HIRS/4**	**39 HIRS/4**	**40 DCS-2**	**41 DCS-2**	**42 HIRS/4**	**43 HIRS/4**	**44 DCS-2**	**45 DCS-2**	**46 47 CPU-A TELEMETRY**	

48 49 50 51 - - - - - CPU-A TELEMETRY - - - - - -				**52 DCS-2**	**53 DCS-2**	**54 HIRS/4**	**55 HIRS/4**	**56 DCS-2**	**57 DCS-2**	**58 HIRS/4**	**59 HIRS/4**
60 DCS-2	**61 DCS-2**	**62 HIRS/4**	**63 HIRS/4**	**64 DCS-2**	**65 DCS-2**	**66 HIRS/4**	**67 HIRS/4**	**68 DCS-2**	**69 DCS-2**	**70 HIRS/4**	**71 HIRS/4**
72 DCS-2	**73 DCS-2**	**74 HIRS/4**	**75 HIRS/4**	**76 DCS-2**	**77 DCS-2**	**78 HIRS/4**	**79 HIRS/4**	**80 SBUV/2**	**81 SBUV/2**	**82 HIRS/4**	**83 HIRS/4**
84 HIRS/4	**85 HIRS/4**	**86 DCS-2**	**87 DCS-2**	**88 HIRS/4**	**89 HIRS/4**	**90 DCS-2**	**91 DCS-2**	**92 HIRS/4**	**93 HIRS/4**	**94 DCS-2**	**95 DCS-2**
96 97 98 99 100 101 - - - - - - - - - - - - - - - - CPU-B TELEMETRY - - - - - - - - - - - - - - -						**102 MIU**	**103 6-** See Note 3	**MINOR FRAME PERIOD - 0.1 SEC MAJOR FRAME PERIOD - 32 SEC OUTPUT DATA RATE - 8.320 KBPS**			

Notes:
1. NUMBER IN UPPER LEFT CORNER INDICATES MINOR FRAME WORD NUMBER
2. Minor Frames 3,4 and 5 consist of 1-bit command verification status in MSB of Word 3, follow frame counter, followed by 9-bit dwell address and 9-bit subcom counter to fill out minor frames
3. Minor Frame 103 consists of 2-bit CPU status in MSB, followed by 6-bit TIP parity.

Table 4.3.3.2-2. TIP Minor Frame format for NOAA-N, -N'

Function	No. of Words	Word Position	Bit No. 1 2 3 4 5 6 7 8 Plus Word Code & Meaning
Frame Sync & SC ID	3	0	11101101 (MSB) is first)
		1	11100010
		2	0000AAAA (Last 4 bits are spacecraft ID)
Status	1-	3	Bit 1: CMD verification (cv) status; 1=cv update word present in frame; 0=no cv update id frame Bits 2&3: TIP status; 00=orbital mode;10=CPU Memory Dump Mode;01=Dwell Mode;11=Boost Mode Bits 4-6: Major Frame Count; 000 Major Frame 0; 111=Major Frame 7; MSB first; Counter incremented every 320 minor frames
Dwell Mode Address	1+		Bits 7&8: 9 bit dwell mode address of analog channel that is being monitored continuously
		3	000000000-Analog channel 0
		4	111111111-Analog channel 511
Minor Frame Counter	1+	4	Bit 8, bits 1-8: 000000000=Minor Frame 0
		5	100111111-Minor frame 319
Command Verification	2	6	Bits 9 thru 24 of each valid received or stored command word are placed in the 16 bit slots of telemetry words 6 and 7 on a one-for-one basis.
		7	
Time Code	5	8,9	9 bits of binary Cay Count, MSB first
		9	Bits 2-5: 0101, Spare Bits
		9,10	27 bits of Binary millisec of Day Count, MSB first

		11 12	Time code is inserted on word location 8-12 only in minor frame 0 of every major frame. The data inserted is referenced to the beginning of the first bit or the minor frame sync word of minor frame 0 within ∀ millisecond.
Digital "B" Subcom-1	1	8	A Subcommutation of Discrete Inputs collected to form 8 bit words. 256 Discrete Inputs (32 words) can be accommodated. It takes 32 frames to sample all inputs once (sampling rate=once/3.2 sec). A Major Frame contains 10 complete Digital "B" subcommutated frames.
Analog Subcom (32 sec)	1	9	A subcommutation of up to 191 analog points sampled once every 32 seconds plus 64 analog points sampled twice every 32 seconds (once every 16 seconds). Bit 1 of each word represents 2560 mV, while Bit 8 represents 20 mV.
Analog Subcom (16 sec)	1	10	This subcommutation is controlled by a PROM located in the TIP and contains 160 word locations with 128 analog channels sampled once every 16 seconds.
Analog Subcom (1 sec)	1	11	This subcommutation is controlled by a PROM in the TIP and contains 10 analog channels sampled once every 1 second. Word 0 of this subcom is filled with data from an analog point selected by command. The selected analog point may be one of the 512 analog points available to the TIP. Bit on of each word represents 2560 mV while Bit 8 represents 20 mV.
Digital "B" Subcom-2	1	12	The subcommutation of discrete inputs collected to form 8 Bit words. 256 discrete inputs (32 words) can be accommodated. It takes 32 minor frames to sample all inputs once (sampling rate=once/3.2 sec). A Major Frame contains 10 complete Digital "B" subcommutated frames. 64 of these bit locations corresponding to TIP minor frames 24-31 form the XSU Digital "A" data. The XSU generates an 8 word subcom which is read out at the rate of one word per minor frame. The XSU subcom is synchronized with its word 1 in minor frame 24.

Analog Subcom-2 (16 sec)	1	13	This subcommutation is controlled by a PROM located in the TIP and contains 160 words locations with 128 analog channels sampled once every 16 seconds. The remaining 32 word locations contain data from the Solar Array Telemetry Commutator Unit (SATCU). The SATCU receives inputs from16 sources on the solar array, commutates them and presents this stream and presents it in the last 32 word locations. The 32 words represent two successive passes through the SATCU subcom.
DAU-1	1	14	8 Bit Housekeeping Telemetry words are formed by the DAU-1 and read out by the telemetry system at an average of 10 words per second.
DAU-2	1	15	8 Bit Housekeeping Telemetry words are formed by the DAU-2 and read out by the telemetry system at an average of 10 words per second.
HIRS/4	36	16,17, 22,23, 26,27, 30,31, 34,35, 38,39, 42,43, 54,55, 58,59, 62,63, 66,67, 70,71, 74,75, 78,79, 82,83, 84,85, 88,89, 92,93	8 Bit words are formed by the HIRS/3 experiment and are read out by the telemetry system at an average rate of 360 words per second.
SEM	2	20,21	8 Bit words are formed by the SEM sensor and ready out by the telemetry system at an average rate of 20 words per second.

DCS-2	32	18,19, 24,25, 28,29, 32,33, 40,41, 44,45, 52,53, 56,57, 60,61, 64,65, 68,69, 72,73, 76,77, 86,87, 90,91, 94,95	8 Bit words are formed by the DCS experiment and are read out by the telemetry system at an average rate of 320 words per second
SBUV/2	4	36,37, 80,81	8 Bit words are formed by the SBUV/2 experiment and read out by the telemetry system at an average rate of 40 words per second.
CPU A Telemetry	6	46,47, 48,49, 50,51	A second block of 16 Bit CPU words is ready out by the telemetry system every minor frame.
CPU B Telemetry	6	96,97, 98,99, 100,101	A second block of 16 Bit CPU words is ready out by the telemetry system every minor frame.
CPU Data Status	1-	103	Bits 1 And 2: 00=All CPU data received 01=All CPU A data received; CPU B data incomplete 10= All CPU B data received; CPU A data incomplete 11=CPU A and CPU B data incomplete
Parity	1-	103	Bit 3: Even parity check in words 2 through 18 Bit 4: Even parity check in words 19 thru 35 Bit 5: Even parity check in words 36 thru 52 Bit 6: Even parity check in words 53 thru 69 Bit 7: Even parity check in words 70 thru 86 Bit 8: Even parity check in words 87 thru bit 7 of word 103

4.3.4 Digital “A” Telemetry

4.3.4.1 HIRS

4.3.4.1.1 HIRS/3

The data from the HIRS/3 are provided to the TIP system from a storage register. The TIP clock pulse (C_1) and Data Select pulses determine the time at which data are called out. The TIP formatter calls out groups of 8-bit words in a sequence that multiplexes HIRS/3 data with that of other instruments. Because of the large quantity of HIRS/3 data to be transmitted and the use of 13-bit decoding of radiometric data, it was not possible to format the HIRS/3 data into neat 8-bit segments. The HIRS/3 data are therefore provided as a continuous stream with 13-bit word lengths. During any minor frame, there are 288 bits of data; each bit is identified as to its purpose.
A full set of HIRS/3 operational data, including command status monitors, housekeeping information and radiance data of the 20 channels, is contained in the Digital "A" output. The HIRS/3 data repeats every 6.4 seconds as described below. The 6.4 second period contains 64 elements.

1) Element Definition

Digital A output is divided into "elements" of 288 bits. An element is phased to fit into a TIP minor frame as described above.

2) Element Formats

Sixty-four elements make up each scan. The formats for the elements repeat every 6.4 seconds and correspond to the particular parts of the scan. Element numbers 0-55 are Earth scan data. Scan element 0 describes the data at the time of viewing the first Earth scan position. Scan element 55 designates the last Earth scan position. Scan elements 56-63 occur during retrace during normal Earth scanning. The same element number designations continue when the scan is commanded to a calibration target. Normally the mirror motion to the warm calibration target takes place during the normal retrace interval. In the case of slew to the space look position, the motion occurs during scan elements 0 to 7.

Data reduction must take this into account as required. The elements are divided as follows:

(a) Bits 1-26

Two 13 bit words have the same function in all 64 elements. The function assembled in these words are as follows:

Word 1	Function	Range (Decimal)
1 - 8	Scan Encoder Position	0 to 199
9 - 13	Electronic Cal Level Indicator	0 to 331

Word 2	Function	Range (Decimal)
1 - 6	Channel 1 Period Monitor	0 to 63
7 - 12	Element Number	0 to 63
13	Filter Sync Designator	n/a

(b) Bits 27-286

This group of bits is divided into 20 13-bit words (20 Ch x 13 Bits). For elements 0-55, these are the Radiant Signal Output. The word functions are dependent on element number. Except for the two status words in element 63, all words are quantity where bit 1 is the sign bit and bits 2 through 13 are amplitude (0 to 4095). Bit 2 is the most significant bit (MSB) and bit 13 is the least significant bit (LSB) of the quantity. The sign bit is:

logic "1"	+ (positive)
logic "0"	- (negative)

The HIRS/3 instrument serial number is preset for each instrument in element 63, bits 42-44. The protoflight has the designation 001; the flight models will be designated 002 on up.

(c) Bits 287 & 288

In the same manner as for bits 1 through 26, these two bits have the same function in all 64 elements. In order to aid determination of times when data should not be used, we have included a Valid Data Bit into the data stream. This bit is a "1" when all conditions are normal and data may be considered good. It will be a "0" when the scan system is in a slew mode or when the filter wheel is not synchronized to the timing system.

Bit 287Valid Data Bit

logic "1"	Valid Data
logic "0"	Ignore Radiometric Data

Minor Word Parity Check is a bit inserted to make the total word odd. This permits automatic checking for data losses in the transmission of the data from the HIRS/3.

Bit 288 Odd bit parity

3) Function Descriptions

Scan Encoder Position - Encoder position is the sensed position of the scan mirror in 1.8 degree increments. The scan positions are described later, but it may be noted that encoder position "1" occurs at the first Earth scan position, hence will be the encoder position noted during element "0".

Electronic Cal Level Indicator - Electronic calibration level advances from 0 to 31, defining the step level measured in each radiometric channel during elements 56 and 57. Since both a positive and negative calibration is made at the end of each scan line, the level applies to both. The step level starts at 0 on the first scan after a calibration start pulse and continues repetitively after that and even when calibration is disabled.

Channel 1 Period Monitor - Measures the variation in time interval of a segment of the filter wheel on each rotation. The reading measures 1.248 MHZ clock intervals of that segment; hence, it defines velocity variations to a granularity of 0.8 microseconds. This is a diagnostic output and is not used in system data processing or evaluation.

Element Number - The number of this data group. It advances from 0 to 63 with element 0 related to the first Earth scan position. The element number repeats regardless of scan position or mode.

Filter Sync Designator - Filter Sync is a "1" when the filter wheel is in synchronism with the timing system. This is diagnostic data not normally used in data collection or processing.

Table 4.3.4.1.1-1 Digital "A" Status Telemetry

Element Number	Bit Number	Function	Remarks
0-55	27-39	Radiometric Channel No.1 (669 cm^{-1})	0 counts radiance from scene equal radiance from filter wheel (FW). Plus (+) values are warmer than FW.
	40-52	Radiometric Channel No.17 (2360 cm^{-1})	0 counts offset from FW radiance. Plus and minus are warmer and cooler than offset.
	53-65	Radiometric Channel No. 2 (680 cm^{-1})	No offset.
	66-78	Radiometric Channel No. 3 (690 cm^{-1})	No offset.
	79-91	Radiometric Channel No.13 (2190 cm^{-1})	Offset.
	92-104	Radiometric Channel No.4 (703 cm^{-1})	No offset.
	105-117	Radiometric Channel No.18 (2515 cm^{-1})	Offset.
	118-130	Radiometric Channel No.11 (1365 cm^{-1})	No offset.

	131-145	Radiometric Channel No.19 (2660 cm^{-1})	Offset.
	146-156	Radiometric Channel No. 7 (749 cm^{-1})	No offset.
	157-169	Radiometric Channel No. 8 (900 cm^{-1})	No offset.
	170-182	Radiometric Channel No.20 (14,500 cm^{-1})	Black is minus. White is plus.
	183-195	Radiometric Channel No.10(1225 cm^{-1})	No offset.
	196-208	Radiometric Channel No.14 (2210 cm^{-1})	Offset.
	209-221	Radiometric Channel No.6 (733 cm^{-1})	No offset.
	222-234	Radiometric Channel No.5 (716 cm^{-1})	No offset.
	235-247	Radiometric Channel No.15 (2240 cm^{-1})	Offset.
	248-260	Radiometric Channel No.12(1488cm^{-1})	No offset.
	261-273	Radiometric Channel No.16 (2270 cm^{-1})	Offset.
	274-286	Radiometric Channel No.9 (1030 cm^{-1})	Offset
56	27-286	Positive Electronics Calibration. Applied to 20 radiometric channels.	Calibration level advances one of the 32 equal level steps on successive scans. The offset and gain of each channel will influence the amplitude of the signal. The calibration level applied to the electronics channels is indicated
57	27-286	Negative Electronics Calibration Applied to 20 radiometric channels	n/a
58	27-91	Internal Warm Target Temperature Sensor #1	Value repeated 5 times. Range 273 to 333 K.
	92-156	Temperature Sensor #2	Value repeated 5 times. Range 273 to 333 K.
	157-221	Temperature Sensor #3	Value repeated 5 times. Range 273 to 333 K.
	222-286	Temperature Sensor #4	Value repeated 5 times. Range 273 to 333 K.
59	27-91	Internal Cold Target Temperature Sensor #1	n/a
	92-156	Internal Cold Target Temperature Sensor #2	n/a
	157-221	Internal Cold Target Temperature Sensor #3	n/a
	222-286	Internal Cold Target Temperature Sensor #4	n/a
60	27-90	Filter Wheel Housing Temperature Sensor #1	Value repeated 5 times. Range 273 to 333 K.
	92-156	Temperature Sensor #1	Value repeated 5 times. Range 273 to 333 K.
	157-221	Temperature Sensor #1	Value repeated 5 times. Range 273 to 333 K.
	222-286	Temperature Sensor #1	Value repeated 5 times. Range

			273 to 333 K.
61	27-90	Patch Temperature Expanded Scale	Value repeated 5 times. Range 90 to 150 K.
	92-156	First Stage Radiator Temperature Sensor	Value repeated 5 times. Range 150 to 320 K.
	157-221	Filter Wheel Housing Current	Value repeated 5 times. Range 0 to 500 mA,
	222-286	Electronic Calibration Digital to Analog	Value repeated 5 times. Range volts 0 to 4 V.
62	27-39	Scan Mirror Temperature	Range 260 to 320 K.
	40-52	Primary Telescope Temperature	Range 260 to 320 K.
	53-65	Secondary Telescope Temperature	Range 260 to 320 K.
	66-78	HIRS/3 Baseplate Temperature	Range 260 to 320 K.
	79-91	HIRS/3 Electronics Temperature	Range 260 to 320 K.
	92-104	Patch Temperature-Full Range	Range 90 to 320 K.
	105-117	Scan Motor Temperature	Range 260 to 320 K.
	118-130	Filter Wheel Motor Temperature	Range 260 to 320 K.
	131-143	Cooler Housing Temperature	Range 260 to 320 K.
	144-156	Patch Control Power	Range 0 to 80 mW
	157-169	Scan Motor Current	Range 0.65 to 1.0 mA
	170-182	Filter Motor Current	Range 100 to 300 mA
	183-195	+15 Vdc	Range 15 $\pm$ 0.2 V
	196-208	-15 Vdc	Range -15 $\pm$ 0.2 V
	209-221	+7.5 Vdc	Range 7.5 $\pm$ 0.05 V
	222-234	-7.5 Vdc	Range -7.5 $\pm$ 0.02 V
	235-247	+10 Vdc	Range 10 $\pm$ 0.2 V
	248-260	+5 Vdc	Range 5 $\pm$ 0.2 V
	261-273	Analog Ground	Range $\pm$ 1 count
	274-286	Analog Ground	Range $\pm$ 1 count
63	27-39	Line Counter (gives the number of lines from the last auto calibration sequence)	0 to 8191 (There is no sign bit used in the line counter). Reset to 0 count is only when counter overflows.
	40-52	First Status Word	First 5 bits are instrument serial number (no sign bit). The remaining bits indicate status as shown in Table 4.3.4.1.1-2.
	53-65	Second Status Word	First 5 bits are zero filled. The remaining bits indicate status as shown in Table 4.3.1.1-2.
	66-78	Data Verification Binary Code	Binary code is: (1,1,1,1,1,0,0,1,0,0,0,1,1) Equivalent to Base 10 value +3,875

	79-91		Base 10 value +1,443
	92-104		Base 10 value -1,522
	105-117		Base 10 value -1,882
	118-130		Base 10 value -1,631
	131-143		Base 10 value -1,141
	144-156		Base 10 value 1,125
	157-169		Base 10 value 3,655
	170-182		Base 10 value -2,886
	183-195		Base 10 value -3,044
	196-208		Base 10 value -3,764
	209-221		Base 10 value -3,262
	222-234		Base 10 value -2,283
	235-247		Base 10 value -2,251
	248-260		Base 10 value 3,214
	261-273		Base 10 value 1,676
	274-286		Base 10 value 1,992

4) Digital "A" Status Telemetry

The last element of each scan, element 63, contains two status words. Bits 45-52 and 58-65 of element 63 are command status bits. Logic state definition is shown in Table 4.3.4.1-2.

Table 4.3.4.1.1-2. Digital "A" Status Telemetry (Element 63, Status Words).

Bit Number	Function	Remarks
First Status Word		
45	Instrument ON/OFF	ON = 1
466	Scan Motor ON/OFF	ON = 0
47	Filter Wheel ON/OFF	ON = 0
48	Electronics ON/OFF	ON = 1
49	Cooler Heat ON/OFF	ON = 0
50	Internal Warm Target Position	True = 0
51	Internal Cold Target Position	True = 0
52	Space Position	True = 0
Second Status Word		
58	Nadir Position	True = 0
59	Calibration Enable/Disable	Enabled = 0
60	Cooler Door Release Enable/Disable	Enabled = 0
61	Cooler Door Open	YES = 1
62	Cooler Door Closed	YES = 1
63	Filter Housing Heat ON/OFF	ON = 0
64	Patch Temperature Control ON/OFF	ON = 0
65	Filter Motor Power High	Normal = 1

4.3.4.1.2 HIRS/4

Digital "A" data from the instrument is described in Table 4.3.4.1.2-1. The TIP clock pulse (C_1) and Data enable pulses determine the time at which the data is called out. The TIP formatter calls out groups of 8-bit words in a sequence that multiplexes HIRS/4 data with that of other instruments on the NOAA-N, -N' spacecraft. Along with this requirement, the large quantity of instrument data to be transmitted and the use of 13-bit encoding of radiometric data, it was not possible to format the data into 8-bit segments. The HIRS/4 data is therefore provided as a continuous stream composed of 13-bit word lengths but clocked out in 8-bit words by the TIP. During any Minor Frame there are 288 bits of HIRS data which are extracted at an equivalent 8,320 bps rate.

The data format remains the same during the 56 earth scan element time periods. During retrace, which is an interval of eight earth scan element time periods, the data format is changed to provide for measurement of the internal electronic calibration and to sample all of the Housekeeping telemetry data.

Scan Element 0 contains the data which describes the scene at the time of viewing the first scan position. The scan positions are described later, but it should be noted that encoder position "1" occurs at the first earth scan position and hence will encoder position noted during element "0". Scan element 55 designates the last scan position. Scan Elements 56-63 occur during the scan mirror retrace during normal earth scanning. These same element number designations apply also when the scan is commanded to a calibration target during the Auto Calibration (Autocal) sequence. Normally the mirror slewing motion between calibration targets takes place during the normal retrace interval except for the case of slew to the space look position where the motion occurs during scan elements 0 to 7. Therefore, space look during Autocal is only for 48 elements (8 through 55).

IN order to determine when radiometric data should not be used, a Valid Data bit is included in the data stream. This bit is a "1" when all conditions are normal and the radiometric data may be considered good. It will be a "0" when the scan system is in a slew mode.

The electronic calibration level advances on level per scan line from 0 to 31, defining the step level measured in each radiometric channel during elements 56 and 57. Since both a positive and negative calibration is made during a scan line, the same level value applies for both.

The Channel 1 Period Monitor measures the time interval of the travel from the Channel 1 to the Channel 2 segments of the filter wheel on each rotation. The reading measures 1,248 MHz clock intervals during that segment, hence defines filter rotation time with a resolution of 0.8 microseconds. This is not used in normal system data processing or evaluation but is a powerful diagnostic tool to aid in assessing the filter wheel subsystem health.

With every filter wheel revolution, a block of data is generated. This block, called an element is 288 bits long. A scan line consists of 56 scene views and eight retrace elements. Thus, there are 64 (56 + 8) filter wheel revolutions per line and 64 elements per scan line. Each element is numbered 0 to 63 and this 6-bit binary number is included in each element at bit location 20-25.

Filter Sync Designator is a “1” when the filter wheel is in synchronized with the data control timing system. This is diagnostic data not normally used in data collection or processing. If the Filter Sync Designator is “0” the radiometric data is not valid.

Radiant Signal Output is the 13-bit binary level measurement of the signals coming from the various detectors. The first bit is a sign bit (“1” positive, “0” is negative). The remaining twelve data bits are straight binary code in order from the most significant to least significant bit.

Mirror Word Parity Check is the lat bit of each Minor Frame or data element and is inserted to make the total number of “ones” in that data element odd. This permits checking for loss of data integrity between transmission from the instrument and the reconstruction on the ground. Elements 58-61 contain the outputs of the temperature and the ECAL DAC, sampled five times during each element. This approach provides a more accurate measurement of the more critical sensor temperatures.

In element 62, the data multiplexer connects other voltage and temperature sensors outputs into the A/D converter for one sample each, thereby allowing monitoring of all the major test points in the system.

Element 63 contains the command status, the instrument serial number, the total line number since the last radiometric calibration (in 13-bit natural binary), and a fixes word pattern and fill bits.

The Instrument Serial Number is unique for each instrument. The HIRS/4 instruments will be designated as 015, 016, 017 and 018.

Command Status is a tabulation of the state of the command relays.

Table 4.3.4.2-1 shows the HIRS/4 Digital “A” output. The only content difference between HIRS/3 data and HIRS/4 data is in element 59.

Table 4.3.4.1.2-1 HIRS/4 Digital "A" Data Output Format.				
Element #	**Bit #**	**Description**	**Range Counts**	**Notes**
0-55 (Earth Scan Elements)	1-8	Encoder Position	0 to 200	
	9-13	Electronic Cal Level	0 to 31	
	14-19	Channel 1 Period Monitor	0 to 63	
	20-25	Element Number	0 to 63	
	26	Filter Sync Designator	0 or 1	
	27-286	Radiant Signal Output (20 Channels x 13 bits)	0 to ± 4095	
	287			
56-63	1-26	Same as Above		
	287,288	Same as Above		
56	27-286	Positive Electronic Calibration. 13 bits for each channel(Cal. Level advances on of 32 equal levels on succeeding scans)		
57	27-286	Negative Electronic Calibration. 13 bits for each channel (Cal. Level advances one of 32 equal levels on succeeding scans)		
58	27-91	Internal Warm Target #1, 13 bits x 5 Times		
	92-156	Internal Warm Target #2, 13 bits x 5 Times		
	157-221	Internal Warm Target #3, 13 bits x 5 Times		
	222-286	Internal Warm Target #4, 13 bits x 5 Times		
59	27-91	Internal Cold Target # 1, 13 bits x 5 Times		
	92-156	Ground		
	157-221	Internal Warm Target #5, 13 bits x 5 Times		
	222-286	Tertiary Telescope Temp, 13 bits x 5 Times		
60	27-91	Filter Housing Temp #1, 13 bits x 5 Times		
	92-156	Filter Housing Temp #2, 13 bits x 5 Times		
	157-221	Filter Housing Temp #3, 13 bits x 5 Times		
	222-286	Filter Housing Temp #4, 13 bits x 5 Times		
61	27-91	Patch Temp Expanded, 13 bits x 5 Times		
	92-156	First Stage Temp, 13 bits x 5 Times		
	157-221	Filter Housing Control Power/Temp, 13 bits x 5 Times		
	222-286	Electronic Calibration DAC, 13 bits x 5 times		
62	27-39	Scan Mirror Temperature		
	40-52	Primary Telescope Temperature		
	53-65	Secondary Telescope Temperature		
	66-78	Baseplate Temperature		
	79-91	Electronics Temperature		
	92-104	Patch Temperature – Full Range		
	105-117	Scan Motor Temperature		
	118-130	Filter Motor Temperature		

	131-143	Radiant Cooler Housing Temperature		
	144-156	Patch Control Power		
	157-169	Scan Motor Current		
	170-182	Filter Motor Current		
	183-195	+15 V dc		
	196-208	-15 V dc		
	209-221	+7.5 V dc		
	222-234	-7.5 V dc		
	235-247	+10 V dc		
	248-260	+5 V dc		
	261-273	Analog Ground		
	274-286	Analog Ground		
63	27-39	Line Count		
	40	Fill Zero		
	41-44	Instrument Serial Number		
	45-52	Command Status		1
	53-57	Fill Zeroes		
	58-65	Command Status		1
	66-78	Binary code (1,1,1,1,110,0,1,0,0,0,1,1,) +3875 (base 10)		2
	79-91	+1443		2
	92-104	-1522		2
	105-117	-1882		2
	118-130	-1631		2
	131-143	-1141		2
	144-156	+1125		2
	157-169	+3655		2
	170-182	-2886		2
	183-195	-3044		2
	196-208	-3764		2
	209-221	-3262		2
	222-234	-2283		2
	235-247	-2251		2
	248-260	+3214		2
	261-273	+1676		2
	274-286	+1992		2
Command Status bits				
63	45	Instrument ON/OFF	ON=1	1
	46	Scan Motor ON/OFF	ON=0	1
	47	Filter Wheel ON/OFF	ON=0	1
	48	Electronics ON/OFF	ON=1	1
	49	Cooler Heat ON/OFF	ON=0	1
	50	Internal Warm Target Position	True=0	1
	51	Internal Cold Target Position	True=0	1

	52	Space Position	True =0	1
	58	Nadir Position	True=0	1
	59	Calibration Enable/Disable	Enable=0	1
	60	Cover Release Enable/Disable	Enable=0	1
	61	Cooler Cover Open	Yes=1	1
	62	Cooler Cover Closed	Yes=1	1
	63	Filter Housing Hear ON/OFF	ON=0	1
	64	Patch Temp Control ON/OFF	ON-0	1
	65	Filter Motor Power HIGH	Normal=1	1

Notes:
1. Command Status Bits
2. Fixed word pattern used to establish data stream synchronization with TIP.

4.3.4.2 SEM-2

SEM-2 data accumulation and transfer are synchronized to the spacecraft's 32 second Major Frame. The Major Frame consists of 320 0.1 second Minor Frames, and SEM-2 is assigned two Digital A data words (20 and 21) per Minor Frame.

The Digital A telemetry format is shown in Table 4.3.4.2-1 which identifies the data assignments for each of the two SEM data words in the 320 Minor Frames constituting one Major Frame.

MEPED Digital A data consists of six directional proton measurements and three directional electron measurements for each of two directions of incidence (0 and 90 degrees) and four omni-directional proton measurements. All but the two highest energy omni-directional proton measurements are read out every two seconds. The two highest energy omnidirectional proton measurements are read out every four seconds. The MEPED Digital A data and readout rates are summarized in Table 4.3.4.2-2.

TED Digital A data consists of a 0.05 to 1 keV partial energy flux measurement, a 1 to 20 keV partial energy flux measurement, maximum differential energy fluxes, four-point differential energy spectra and background measurements for electrons and protons, each at two angles of incidence (0 and 30 degrees). The TED Digital A output data and readout rates are summarized in Table 4.3.4.2-3. Note that the four differential energy flux maximum channel identifiers (OEM, OPM, 3EM and 3PM) are each four bits long (each identifies 1 of 16 channels) and are combined into two 8 bit words (OEM/OPM and 3EM/3PM). Note also that two (0 and 30 degrees) proton four-point differential energy spectra are read out only three times every 32 seconds, while the two (0 and 30 degrees) electron four-point differential energy spectra are read out four times every 32 seconds (every 8 seconds). Sensor background data and synchronization words are read out in place of the fourth proton four-point differential energy spectral data.

Table 4.3.4.2-1. SEM Digital "A" Telemetry Data Assignments																	
Minor Frame # Data in Word 20 Data in Word 21	0 CKSM 0P1	20 TED SWP VAN SUB5	40 TED E CEM HV	60 TED P CEM HV	80 MEP OMN I BV	100 AN SUB 1	120 AN SUB 2	140 AN SUB 3	160 AN SUB 4	180 TED IPC V	200 MEP IFC V	220 BL 1	240 BL 2	260 BL SUB	280 0E BK H	300 3EB KH	House Keeping
.1 sec	1 0P2 0P3	21	41	61	81	101	121	141	161	181	201	221	241	261	281	301	MEPED 0 degree Temperature
	2 0P4 0P5	2	42	62	82	102	122	142	162	182	202	222	242	262	282	302	
	3 0P6 0E1	23	43	63	83	103	123	143	163	183	203	223	243	263	283	303	
	4 0E2 0E3	24	44	64	84	104	124	144	164	184	204	224	244	264	284	304	
	5 9P1 9P2	25	45	65	85	105	125	145	165	185	205	225	245	265	285	305	MEPED 90 degree Temperature
	6 9P3 9P4	26	46	66	86	106	126	146	166	186	206	226	246	266	286	306	
	7 9P5 9P6	27	47	67	87	107	127	147	167	187	207	227	247	267	287	307	
	8 9E1 9E2	28	48	68	88	108	128	148	168	188	208	228	248	268	288	308	
	9 9E3 P6	29	49	69	89	109	129	149	169	189	209	229	249	269	289	309	MEPED OMNI
.1 sec	10 P7 98	30	50	70	90	110	130	150	170	190	210	230	250	270	290	310	
	11 ODE1 ODE2	31 3DE1 3DE2	51 0DP1 3DP2	71 3DP1 3DP2	91 0DE1 0DE2	111 3DE1 3DE2	131 0DP1 0DP2	151 3DP1 3DP2	171 0DE1 0DE2	191 3DE1 3DE2	211 0DP1 0DP2	231 3DP1 3DP2	251 0DE1 0DE2	271 3DE1 3DE2	291 OEBKL 2EBKL	311 Sync F3 3PBKL	TED Differences

	12 ODE3 ODE4	32 3DE3 3DE4	52 0DP3 0DP4	72 0DP3 0DP4	92 0DE3 0DE4	112 3DE3 3DE4	132 0DP3 0DP4	152 3DP3 3DP4	172 0DE3 0DE4	192 0DE3 0DE4	212 0DP3 0DP4	232 3DP3 3DP4	252 0DE3 0DE4	272 3DE3 3DE4	292 0PBKL 0PBLH	312 Sync 50 3pbkh	
	13 OEFL 3EFL	33	53	73	93	113	133	153	173	193	213	233	253	273	293	313	TED Low Differences
	14 0PFL 3PFL	34	54	74	94	114	134	154	174	194	214	234	254	274	294	314	
	15 0EFH 3EFH	35	55	75	95	115	135	155	175	195	215	235	255	275	295	315	TED High Differences
	16 03FH EPFH	36	56	76	96	116	136	156	176	196	216	236	256	276	296	316	
	17 0EM/0 PM/ 0DEM	37	57	77	97	117	137	157	177	197	217	237	257	277	297	317	TED PERK FLUX
	18 0DPM 3EM/ 3PM	38	58	78	98	118	138	158	178	198	218	238	258	278	298	318	
	19 3DEM 3DPM	39	59	79	99	119	139	159	179	199	219	239	259	279	299	319	
		2 sec	4 sec		8 sec				16 sec				24 sec				32 sec
Note: Dash indicates data is the same as in previous column																	

Table 4.3.4.2-2. MEPED Digital "A" Data.				
Particle Type	**Sensor**	**Detected Energy Range**	**Readout Time(s)**	**Mnemonics**
Proton	Telescope 0/90 Degrees	30-80 keV	2	0P1,9P1
		80-250 keV	2	0P2,9P2
		250-800 keV	2	0P3,9P3
		800-2500 keV	2	0P4,9P4
		2500-7000 keV	2	0P5,9P5
		> 7000 keV	2	0P6,9P6
Electron	Telescope 0/90 Degrees	≥30 keV	2	0E1, 9E1
		≥100 keV	2	0E2,9E2
		≥300 keV	2	0E3, 9E3
Proton	Omni-directional	≥ 16 MeV	2	P6
		≥ 35 MeV	2	P7
		≥ 70 MeV	2	P8
		≥ 140 MeV	2	P9

Table 4.3.4.2-3. TED Digital "A" Data.			
Definition(See Note 1**)**	**Readout Time(s)**	**Mnemonics**	**Notes**
0.05-1 keV Partial Energy Flux	2	0EFL,0PFL,3EFL,3PFL	
2-10 keV Partial Energy Flux	2	0EFH,0PFH,3EFH,3PFH	
Maximum Differential Energy Flux	2	0DEM,0EPM,3DEM,3DPM	
Energy of Maximum Differential Energy Flux	2	0EM,0PM,3EM,3PM	2
Four Point Energy/Flux Spectrum	8	0DE1,0DE2,0DE3,0DE4, 3DE1,3DE2,3DE3,3DE4, 0PD1.0PD2,0PD3,0PD4, 3PD1,3PD2,3PD4,3PD4	3,4
Background	32	0EBKH,0EBKL,0PBKH,0PBKL	

Notes:
1. Four sets of measurements are made: electrons at 0 degrees, protons at 0 degrees, electrons at 90 degrees and protons at 90 degrees.
2. Four bits each, combined into two data words (0EM/0PM and 3EM/3PM).
3. Differential energy channels 4, 8, 11 and 14 (based on 1-16).
4. The four-point proton spectra are read three times every 32 seconds.

4.3.4.3 SBUV/2

Digital "A" data is clocked into the spacecraft TIP whenever the "A_1" Data Enable Pulse is presented to the instrument. Digital "A" data include both instrument data and any housekeeping telemetry required for reduction of observation data. The data format differs with the various SBUV/2 operating modes as described below.

4.3.4.3.1 Discrete Mode

The instrument views the earth's atmosphere or the sun if the diffuser is so deployed. In this mode, radiometric data is taken at twelve discrete wavelengths. The data format for this mode is shown in Table 4.3.4.3.1-1. Further details of the data format are provided in Tables 4.3.4.3.1-2, 4.3.4.3.1-3, 4.3.4.3.1-4, 4.3.4.3.1-5 and 4.3.4.3.1-6.

4.3.4.3.2 Sweep Mode

The instrument grating sweeps from approximately 400 nm to 160 nm, and data is taken in 0.15 nm increments. If SBUV/2 is viewing the earth, the scene spectral radiance is being measured. If the diffuser is deployed, the instrument is measuring the solar irradiance.

4.3.4.3.3 Wavelength Calibration Mode

The instrument views an on-board Hg lamp source at 12 discrete grating positions bracketing a particular source line. The data format for this mode is the same as that for the Discrete Mode, as shown in Table 4.3.4.3.1-1.

Table 4.3.4.3.1-1. SBUV/2 Data Format Discrete Modes (See Note 1).

Line (See Note 3**)**	**TIP Minor Frames (See Note 2)**	**Function**		**Sample Time**		**Integration Interval**	
		Word 1 (See Note 4)	**Word 2 (See Note 4)**	**Word 1(See Note 7)**	**Word 2**	**Word 1**	**Word 2**
L0	0, 10, 20,…, 310	Status Word 1	Range 1 Data	End of L0, Channel N-1	End of L9, Channel N-1	n/a	1 ¼ sec and ¼ sec (See Note 8)
L1	1, 11, 21,…, 311	Status Word 2	Range 2 Data	Channel N-1	End of L9, Channel N-1	n/a	1 ¼ sec and ¼ sec (See Note 8)

L2	2, 12, 21,…, 312	Analog Sub Mux	Range 3 Data	End 0f L0/L1, Channel N	End of L9, Channel N-1	0.1 sec	1 ¼ sec and ¼ sec (See Note 8)
L3	3, 13, 23,…, 313	Memory Verify	0000	End of L1, Channel N	n/a	n/a	n/a
L4	4, 14, 24,…, 314	Status Word 3	0000	Start of L0, Channel N	n/a	n/a	n/a
L5	5, 15, 25,…, 315	Status Word 4	0000	Start of L0, Channel N	n/a	n/a	n/a
L6	6, 16, 26,…, 316	Grating Position	0000	½ into L7 Alternates End of L9,Chan N-1	n/a	n/a	n/a
L7	7, 17, 27,…, 317	CCR Data	0000	End of L9, Channel N-1	n/a	1 ¼ sec (See Note 8) and ¼ sec	n/a
L8	8, 18, 28,…, 318	RDCL/GP E (See Note 6)	0000	End of L6/L7, Channel N	n/a	0.1 sec	n/a
L9	9, 19, 29,…, 319	Frame Code Sync	0000	Start of L0, Channel N	n/a	n/a	n/a

Notes:
1) Include discrete, calibration and position modes.
2) Format is the same for all major frames.
3) The basic SBUV/2 data frame is a 20-block repeating a one second intervals.
4) Word 1 corresponds to the 16 bits in TIP words 36 and 37, MSB sent first. Word 2 corresponds to the 16 bits in TIP words 80 and 81, MSB sent first.
5) Analog sub-mux is 16 channels deep.
6) Radiometric DC level/grating position error.
7) Channel N is the present 1 second time interval. Channel N-1 is the previous 1 second time interval.
8) In every two second interval, signal integration occurs between ¾ and 2 sec; signal is sampled and readout at the end of 1 sec and two sec.

Table 4.3.4.3.1-2. SBUV/2 Data Format Discrete Mode Detailed Description

Name of Function	Format Location		Bit Numbers MSB LSB															
	Word	Line	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Frame Sync Code nd Sub-multiplexer Channel Number	1	9	2^3	2^2	2^1	2^0	1	1	0	1	0	1	1	0	0	0	0	0
Frame Sync Sub-multiplexer Cannel Numbers (Full Scale Counts 255 = 5.1 V, all analog channels																		
Analog Sub-Mux (see Table 4.3.4.3.1-7 for commutation scheme)	1	2	Channel A								Channel B							
			2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Radiometric DC Level/Grating Position Error (See Note 3)	1	8	Full Scale Counts 255 = 5.1 Volts, Note: RDCL F.S. Current 91.5 pa															
Monochromator Range Data	2		2^{15}----------2^0															
			Maximum Count = 65,535 (See Note 1), Full Scale Counts = 65,536															
				Full Scale Current														
				Disc							Sweep							
		0	Range 1 (see Note 2)	100 pa							1.25 na							
		1	Range 2 (see Note 2)	10 na							125 na							
		2	Range 3 (see Note 2)	1 :a							12.5 :a							
Cloud Cover Radiometer Data	1	7	CCR	2.4 na							30 na							
Memory Verification Repeats every 128 sec Reads memory as indicated by memory bits shown to right Memory location readout in order starting with Word 0 segment 0 of fixed memory at TIP major frame pulse	1	3	2^{12} position data in Memory								$2^0S^1S^2F$							
			Segment								S^1	S^0	Program	F				
			0								0	0	Fixed	1				
			1								0	0	Flex	0				
			2								1	0						
			3								1	1						
Grating Position Number greater than 0 = CW of Index	1	6	2^{12} 2^0 S_1 S_2 L															
			Segment Being Read								S_1					S_0		
			0								0					0		

Index = all zeroes 1 bit CW = 0 1 bit CCW = all ones			1	0	1			
			2	1	0			
			3	1	1			
			This is the actual position number. Code is in 2's complement. Digital Lock L=1 (locked).					
Range Identification	Status Words 1 and 2		Range Selected	Bit A	Bit B			
			R_1	0	1			
			R_2	1	0			
			R_3	1	v1			
Sweep Mode Major Frame Counter	Status Word 1 Bits 3,4 & 5		Frame	Count	Bit No.			
			None	0	3	4	5	
			(First)	1	0	0	0	
			2	2	0	0	1	
			3	3	0	1	0	
			4	4	0	1	1	
			5	5	1	0	1	
			6(Last)	6	1	1	0	

Notes:
1) Overflow flags (status 3 bits 1, 2, 3 and 4).
2) Current referred to the PMT anode.
3) Grating Motor Current, Grating Position Error and Grating Coarse Error are expected to always read 0 to 10 counts (telemetry points are grounded) and data should be disregarded.

Table 4.3.4.3.1-3. SBUV/2 Data Discrete Mode Temperature Monitor Description.

Temperature Monitors:
1. Differential Monitors $T_D = T_A - T_R$; $N_A = N_R + 0.1075\ N_D - 13.7$ (See Note 1)
2. Single Point Monitors:

Temperature (Degrees C)	Thermistor (Ohms)	Output volts/Counts (N)				
		Shroud -30 to 80	Differential A to B Reference	0 to 80 degrees	-15 to 45 degrees	-5 to 35 degrees
-30	135.2 K	4.74/237				
-20	78.91 K	4.57/228			5.15	
-15	61.02 K	4.45/222	3.58/179		5.01/250	
-10	47.54 K	4.32/216	3.41/170	5.513	284.242	5.17
-5	37.31 K	4.16/208	3.22/161			4.95/247
0	29.49 K	3.99/199	3.01/150	4.98/249	4.42/221	4.70/235
5	23.46 K	3.79/189	2.79/140			
10	18.79 K	3.57/178	2.57/128	4.35/217	3.92/196	4.13/206
15	15.13 K	3.34/167	2.33/117			
20	12.26 K	3.10/155	2.11/105	3.67/183	3.36/166	3.52/176
25	10.00 K	2.86/143	1.89/94	3.33/167	3.08/154	
30	8.194 K	2.61/130	1.68/84	3.00/150	2.79/139	2.90/145
35	6.752 K	2.37/118	1.48/74			2.60/130
40	5.592 K	2.14/107	1.30/65	3.29/119	2.25/112	2.32/116
45	4.655 K	1.91/95	1.14/57		2.01/100	
50	3.893 K	1.71/85		1.86/93	1.78/89	1.82/91
60	2.76 K	1.35/67		1.44/72	1.39/69	1.41/70
70	1.99 K	1.05/52		1.1/55	1.08/54	1.09/54
80	1.458 K	0.81/41		0.85/42	0.831/41	

Note:
1. N_A = Thermistor "A" temperature in counts, N_D = Differential Temperature in counts and N_R = Reference Temperature in counts.

Table 4.3.4.3.1-4. SBUV/2 Data Format Discrete Mode Voltage and Current Monitors Description.

Voltage Monitors	
Function	**Conversion Factor**
HVPS Volts	6 V/N (See Note 1)
E Cal Ref	0.04 V/N, 6.4 V/160 Counts Nominal, ∀ 0.6 V limits
15 V Sensors	0.1 V/N, 15V/150 Counts Nominal, ∀3.0 V limit
-15 V Sensors	$V = 0.6083\ N_5 - 0.5059\ N_{15}$ (See Note 2)
24 V Motor	0.198 V/N, 24 V/121 Counts Nominal, ∀ 5 V limits
5 V LED	0.0333 V/N, 5V/150 Counts Nominal, ∀ 1 V limits

10 V Logic	0.0667 V/N, 10 V/150 Counts Nominal, ± 1 V limits
28 V (See Note 1)	9.912 V/N, 28 V/2.82 V Nominal, ± 4 V limits
25 V	0.198 V/N, 25 V/126 Counts Nominal, ± 2.5 V limits
15 V Servo	0.1 V/N, 15 V/150 Counts Nominal, ± 1.5 V limits
-15 V Servo	$V = 0.6083\ N_5 - .05059\ N_{15}$ (See Note 2)
Thermistor Bias (10V)	0.0667 V/N, 10 V/150 Counts Nominal, ± 1 V limits
Current Monitors	
Chop Motor	0.002 A/N
Diffuser Motor	0.004 A/N
Cal Lamp Current	5.22 :A/N
Lamp Motor	0.004 A/N
Cal Lamp Heater	0.1 A/Current .017 A nominal
Miscellaneous	
Chopper Phase Error	0.0985 V/N
Notes: 1. Analog Telemetry 2. N = counts, N_5 counts from 5V LED, N_{15} counts from 15 V LED	

Table 4.3.4.3.1-5. SBUV/2 Description of Command Sequence State Monitors.

Command (CMD) Sequence State					
		2^2	2^1	2^0	
Discrete Sun Command Sequence	1-0	0	0	0	Discrete Sun Enable ON
	1-1	0	0	1	
	1-2	0	1	0	
		All other states not valid			
Sweep Sun Command Sequence Step No.	2-0	0	0	0	Sweep Sun Enable ON
	2-1	0	0	1	
	2-2	0	1	0	
	2-3	0	1	1	
		All other states not valid			
W/L (See Note 1) Calibration Command Sequence Step No.	3-0	0	0	0	W/L Calibration ON
	3-1	0	0	1	
	3-2	0	1	0	
	3-3	0	1	1	
	3-4	1	0	0	
	3-5	1	0	1	
	3-6	1	1	0	
	3-7	1	1	1	

		All other states not valid	

Note:
1. W/L = wavelength

Table 4.3.4.3.1-6. Data Description of the Electronic Calibration Step Decoding using Timing Monitors and the Retrace Monitor.

Timing Monitors				
E Cal Step No.	**16 sec**	**8 sec**	**4 sec**	**Retrace**
A	1	0	0	ON
B	1	0	1	
C	1	1	0	
D	1	1	1	
E	0	0	0	
A	0	0	1	
A	0	1	0	
A	0	1	1	
E Cal OFF				OFF

Note:
Timing monitors are sampled at Channel N-1 (I sec prior to readout).

Table 4.3.4.3.1-7. SBUV/2 Data Format Discrete Mode Analog Sub-Multiplexer Data Assignment

Bits 1 through 8 Channel 8		**Bits 9 through 16 Channel B**	
Channel #	**Function**	**Channel #**	**Function**
1A	Chop Motor Current	1B	Spare
2A	Differential Motor Current	2B	Diffuser Plate Temperature (See Note 1)
3A	HVPS volts	3B	SM Baseplate Temperature (See Note 2)
4A	Thermistor Bias (10 V Reference)	4B	25 V Power Volts
5A	Calibration Lamp Temperature (See Note 1)	5B	15 V Servo Volts
6A	Electronic Calibration Reverence Volts	6B	-15 V Servo Volts
7A	15 V Sensors Volt	7B	CCR Diode Temperature (See Note 3)
8A	-15 V Sensors Volts	8B	SM Differential Temperature Y-Axis (See Note 4)
9A	24 V Motor Volts	9B	SM Differential Temperature Z-Axis (See Note 4)

10A	5 V LED Volts	10B	Differential Reference Temperature Z-Axis
11A	10 V Logic Volts	11B	Differential Reference Temperature Y-Axis
12A	Calibration Lamp Current	12B	PMT Cathode Temperature (See Note 3)
13A	Spare	13B	Spare
14A	Signal Return	14B	Chopper Phase Error
15A	Signal Return	15B	Spare
16A	Lamp Motor Current	16B	Spare
Notes: 1. 0 to 80 degrees C 2. -15 to 45 degrees C 3. -5 to 35 degrees C 4. ∀ 5 degrees C			

4.4 DATA COLLECTION AND LOCATION SYSTEM

4.4.1 GENERAL

The Data Collection System (DCS) on the NOAA KLM spacecraft is provided by CNES of France. This system provides a means to collect data and/or locate fixed and mobile buoy and balloon platforms. A complete description of the system is contained in Section 3.6.

If the data platforms and receive site are simultaneously in the view of the satellite, the Data Collection System provides the immediate rebroadcast of data from the platform, received by the satellite via an UHF uplink. These data are included as 32 8-bit words in the TIP minor frame. As such, it is available in both the low data rate DSB and high data rate HRPT services. Since the data rate on the new DCS/2 instrument has been increased from 1200 to 2560 bps, the number of TIP words allocated to DCS has been increased to 32 from the previous spacecraft series. However, interpretation of the telemetry remains unchanged. The DCS data in the direct broadcast services will only permit platform location computations with the proper computer software. More details can be obtained from Service ARGOS, as noted in Appendix E.