CHARACTERISTICS OF FY-2C/D/E S-VISSR DATA TRANSMISSION

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1. Introduction

The FY-2 series of geo-stationary meteorological satellites are operated by China Meteorological Administration (CMA). The first two satellites of FY-2, namely FY-2A and FY-2B, were experimental and launched on June 10, 1997 and June 25, 2000, respectively. The successive 3 satellites named as FY-2C/D/E are operational and will cover the period till 2012 around.

This document provides necessary information for Medium Data Utilization Station (MDUS) users to receive and process the stretched Visible Infrared Spin Scan Radiometer (S-VISSR) data of FY-2C/D/E satellites. The 2nd chapter describes major differences in S-VISSR data transmission between FY-2C/D/E and FY-2B. The 3rd chapter gives the FY-2C/D/E data transmission format defined as S-VISSR2.0.

The principal characteristics at the physical layer of S-VISSR data transmission are given in Table 1.

Table 1. Principal characteristics at the physical layer of S-VISSR data transmission

	Contents
Frequency	1687.5 MHz
Modulation	DPSK / PCM
Bit rate	660Kbps
E.I.R.P	57±1.5dBm
Band width	Less than 2MHz
Frame length	364848 bits (including SYNC code)
Coding scheme	Byte complementing and PN scrambling
Sequence of bits	Most Significant Bit (MSB) first

2. Change from S-VISSR of FY-2B to S-VISSR2.0

2.1 SYNC Code

FY-2B S-VISSR data stream contains 20000 bits of SYNC Code to start with fixed 010001001100001 and end with 15 logical “1” (111111111111111). However, for S-VISSR2.0, the length of SYNC Code is shortened to 10000 bits due to limited transmission time.

2.2 Document Sector

FY-2C/D/E S-VISSR2.0 Document Sector remains compatible in data format with that of FY-2B S-VISSR, but the contents change in the following:

(1) In the Orbit and Attitude Data Block, the orbit and attitude parameters are described in the mean J2000.0 coordinate system, rather than J1950.0.

(2) In the Constants Block, the WGS-84 Standard is used for the earth constants.

(3) Calibration Data Block for the 10 bits observation data is added.

2.3 Image Data

The FY-2B had 3 channels, namely infrared (IR1, 10.5～12.5μm), water vapor (IR2, 6.5～7.0μm) and visible (VIS 0.55～1.05μm) channels. Each scanning step produces one line of IR1 data, one line of IR2 data, and four lines of VIS data. These data are arranged in S-VISSR shown as Table 2.

Table 2. Arrangement of FY-2B S-VISSR image data

S-VISSR imagery data stream						
8-bit data			6-bit data			
IR1 Infrared channel	IR2 Water vapor channel	Reserved bytes	VIS1 Visible Detector 1	VIS2 Visible Detector 2	VIS3 Visible Detector 3	VIS4 Visible Detector 4

The FY-2C/D/E satellite's Scan Radiometers are different from FY-2B in that:

(1) The infrared channel 10.5～12.5μm is split into two channels, i.e. 10.3～11.3μm and 11.5～12.5μm.

(2) An additional medium wave infrared channel 3.5～4.0μm is added.

(3) The spectrum of visible channel is 0.55～0.90μm, rather than 0.5 ～ 1.05μm.

The definition of FY-2C/D/E satellite observation channels is given in Table 3.

Table 3. FY-2C/D/E satellite scan radiometer channel definition

Channel ID	Channel name	Spectral range (μm)
IR1	long wave infrared	10.3～11.3
IR2	split window	11.5～12.5
IR3	water vapor	6.5～7.0
IR4	medium wave infrared	3.5～4.0
VIS 1～4	visible	0.55～0.90

In addition, for FY-2C/D/E, the infrared channels have 1024 (10-bit) quantization level, increased from FY-2B with 256 (8-bit). The upper 8-bit data of IR1～IR3 and VIS1～VIS4 of FY-2C/D/E are placed in the same way as S-VISSR of FY-2B, the lower 2-bit data of IR1～IR3 are placed after the VIS data and then followed by IR4 data, shown in Table 4.

Table 4. Arrangement of FY-2C/D/E S-VISSR2.0 data

S-VISSR 2.0 imagery data stream										
IR1～IR3 Upper 8-bit data			VIS1～VIS4 6-bit data				IR1～IR3 Lower 2-bit data			IR4 10-bit data
IR1	IR2	IR3	VIS 1	VIS2	VIS3	VIS4	IR1	IR2	IR3	IR4

3. FY-2C/D/E S-VISSR2.0 Transmission Format

As shown in Table 5, the S-VISSR2.0 data format begins with SYNC code to be followed subsequently by documentation sector, the upper 8 bits of IR1～IR3 image data, visible channel image, the lower 2 bits of IR1～IR3 image data, and the IR4 channel image.

Table 5. Format of FY-2C/D/E S-VISSR2.0 data

SYNC Code	Information sectors											
	Doc. Sector	Image data sectors										
		IR1～IR3 upper bits data sector (8 bits)			VIS1～VIS4 data sector (6 bits)				IR1～IR3 lower bits data sector (2 bits)			IR4 data Sector (10 bits)
SYNC	DOC	IR1	IR2	IR3	VIS1	VIS2	VIS3	VIS4	IR1	IR2	IR3	IR4
10000	20408	20408	20408	20408	57060	57060	57060	57060	6662	6662	6662	24990
364848 bits (552.8 milliseconds)												

3.1 SYNC Code

SYNC code is transmitted to allow bit and frame synchronization by demodulators and decoders at the user stations. It consists of 10000 bits in Pseudo-random Noise (PN) sequence generated by means of a 15-digit serial shift register. It begins with the fixed pattern (011001110011111) at the beginning of every line and ends with 15 logic ones (111111111111111). Subsequent S-VISSR image data are encoded by the PN sequence to distribute RF energy evenly after modulation because the image data may contain consecutive logic zeros or ones. This scheme is also effective in maintaining bit-sync-lock of the MDUS demodulator.

3.2 Information sectors

As shown in Table 5, the S-VISSR2.0 has 12 information sectors with the leading 8 sectors being compatible with the FY-2B S-VISSR format.

The 1st sector is Documentation sector. The 2nd to the 4th sectors are the upper 8 bits of IR (IR1 ～ IR3) image data. The 5th to 8th sectors are visible (VIS 1～VIS 4) image data. The 9th and 11th sectors are the lower bits of IR (IR1～IR3) image data. The 12th sector is IR4 image data. Each information sector has its discrimination code (ID code) at the beginning of the sector, to be followed by the information contents and then the 16 bits Cyclic Redundancy Check (CRC) code and 2048 bits of logic zeros (Filler) at the end. The cyclic redundancy check (CRC) code is 16 bits error/detection data generated by the following operational polynomial:

$$G(X)=X^{16}+X^{12}+X^{5}+1$$

The structure of each information sector is given in Table 6. The unit length is bit.

Table 6. Structure of the information sectors

Sector No.	Sector name	ID code	Doc. Information or Image data	CRC	Filler
1	Documentation sector	16	18328	16	2048
2	IR1 upper 8 bits sector	16	18328 (2291×8)	16	2048
3	IR2 upper 8 bits sector	16	18328 (2291×8)	16	2048
4	IR3 upper 8 bits sector	16	18328 (2291×8)	16	2048
5	VIS1 sector	12	54984 (9164×6)	16	2048
6	VIS2 sector	12	54984 (9164×6)	16	2048
7	VIS3 sector	12	54984 (9164×6)	16	2048
8	VIS4 sector	12	54984 (9164×6)	16	2048
9	IR1 lower 2 bits sector	16	4582 (2291×2)	16	2048
10	IR2 lower 2 bits sector	16	4582 (2291×2)	16	2048
11	IR3 lower 2 bits sector	16	4582 (2291×2)	16	2048
12	IR4 sector	16	22910 (2291×10)	16	2048

3.2.1 Documentation sector

The Documentation sector is divided into the following 10 information blocks: Sector ID block, Spacecraft (S/C) and CDAS status block, Constants block, Sub-commutation ID block, Simplified mapping block, Orbit and attitude data block, MANAM block, Calibration block-1, Calibration block-2, and Spare block. The format of Documentation sector is given in Table 7. The unit word length is byte (8 bits).

(1) Sector ID block
This block contains 2 bytes (16 bits), both filled with logic zeros as identification of the Documentation sector.

(2) S/C and CDAS status block
This block consists of 126 bytes (16 bits). It conveys information necessary to process data, such as Picture Flag, Scan Count (Line Number) and Time of data acquisition in each line. See Table 8 "S/C & CDAS documentation block" for details.

The nominal position of FY-2C/D/E satellites is 105^{o}E. The range of observation is illustrated by Annex-1. Such parameters as the picture flag and frame flag described in Table 8 are also indicated in Annex-1.

(3) Constants block
This block consists of 64 words to be filled with useful constants. See Table 9 "Constant Block" for details of these constants.

(4) Sub-commutation ID block
Blocks from Simplified Mapping Block through to Spare Block are disseminated by Sub-commutation technique because the volume of the data is too large to be contained in one line; the total volume is divided into 25 groups and each group is transmitted in 8 consecutive scan lines repeatedly to reduce transmission error. Therefore, the transmission of a complete information block containing parameters block for simplified mapping, orbit and attitude data, MANNM and calibration data requires 200 lines. The Sub-documentation ID indicates each of the 200 lines.

The Sub-commutation ID block consists of 4 bytes. The first and the third counters (the 193rd and 195th byte of Documentation) are always set zero. The second counter (the 194th byte of Documentation) is the repeat counter indicating Sub-commutation ID and increments from 0 to 24 for the 25 Documentation text groups. The fourth counter (the 196th byte) is also the repeat counter and increments from 0 to 7 for each repeated line of a group. Table 10 illustrates the structure of Sub-commutation ID block.

(5) Simplified mapping block
This block contains a part of list which indicates the mapping information between pixel coordinates and geographical coordinates.

The mapping values indicate line numbers and pixel numbers of 25×25 grid points on an image, which correspond to the points on geographical coordinates of every 5 degree between 60 degrees north and 60 degrees south of latitude and 45 degrees east and 165 degrees east of longitude. The format of the block is indicated in Table 11.

The size of the entire block is 2,500 bytes and divided into 25 groups of 100 bytes each, and one of the 100-bytes groups is sent repeatedly 8 times. The entire mapping grid requires 200 lines to complete. The number of the group in the frame could be identified by "Sub-commutation ID" in the Sub-commutation ID block. Conversion of the geographical coordinates to pixel coordinates can be easily achieved by interpolation of the simplified mapping data for image navigation.

(6) Orbit and attitude data block

The block contains 128 bytes. A text of data is composed of 3,200 words conveyed by Sub-commutation technique, which provide parameters indispensable to determine precise geometric positions of the pixels. The mapping method uses the information on the satellite's orbit and attitude included in this block. In the block, orbit and attitude data are calculated at the epoch time and are predicted for the time around the observation. Users will be able to obtain the accurate mapping matrices from these parameters. The contents of orbit and attitude data is given by Table 12～14.

(7) MANAM block

This block consists of 10,250 bytes. It is updated weekly to inform users the schedule of satellite observation and the information of system maintenance.

MANAM block is conveyed by Sub-commutation technique, and it consists of 25 groups of five ASCII strings, each group has 410 bytes. Each string has the width of 82 bytes, including 80 characters, terminator (CR), and line feed (LF). 200 lines are needed to include all information of MANAM block.

Annex-3 and Annex-4 are examples of MANAM of FY-2C/D/E satellite operation schedule in the normal and the flooding season modes, respectively.

(8) Calibration block 1

Calibration block 1 contains simplified calibration lookup table corresponding to the 8 bits of IR data. The length of the block is 6400 bytes and conveyed by sub-commutation technique. It is divided into 25 groups of 256 bytes each. See Table 15.

(9) Calibration block 2

Calibration block 2 contains complete calibration lookup table and is conveyed by Sub-commutation technique. The Calibration block 2 consists of 25 groups with 1024 bytes each. See Table 16.

Table 7. Format of documentation sector of S-VISSR2.0

Sector ID	S/C and CDAS status block	Constants block	Sub–communication ID block	Simplified mapping block	Orbit and attitude data block	MANAM block	Calibration block-1	Calibration block-2	Spare block
2	126	64	4	100	128	410	256	1024	179
2	2291 bytes (18328 bits)								
2293 bytes									

Table 8 S/C & CDAS documentation block (126 words)

Word No.	Type	Contents	Description
1	1*1	Scan Mode	$00_{(16)}$ Normal Scan $0F_{(16)}$ Partial or hemispheric observation 01 ～ 15 minute observation $FF_{(16)}$: Single line scan
2	1*1	Scan Status Scan status is indicated by 2 bits. b_1,b_2: Forward observation from North to South: "1,1" b_3,b_4: Reverse : "0,0" b_5,b_6: Step Normal (one step / spin) : "1,1" b_7,b_8: Step Rapid (10 steps / spin) : "0,0" Step scan off : all bits = "0"	This item indicates the status of the imager. Forward observation of the imager is from the North to the South. The word bit sequence is $b_8b_7b_6b_5b_4b_3b_2b_1$. MSB is b_8, LSB is b_1. Normally the radiometer takes a step forward after finishing one spin.
3	1*1	Frame flag $FF_{(16)}$ Frame flag ON $00_{(16)}$ Frame flag OFF	This flag is used to distinguish if the line contains significant data transmission including calibration line data. $FF_{(16)}$: with significant data; $00_{(16)}$: without significant data.
4	1*1	Picture flag $FF_{(16)}$ Picture flag ON $00_{(16)}$ Picture flag OFF	This flag is used for distinguishing the S-VISSR image (the Globe). The center of Earth disk is in the middle of globe image that contains 2,991 scan lines. FF: significant picture data transmission; 00: insignificant.
5-6	BCD*2	Picture flag Set Line Number Line number significant picture flag	Line number after Picture Flag is turned ON.

Table 8 (continued)

Word No.	Type	Contents	Description
7-8	BCD*2	Picture flag Reset Line Number Line number insignificant picture flag	Line Number after Picture Flag is turned OFF. Reset Line Number minus Set Line Number is 2,291.
9-10	BCD*2	Scan Count（1） Scan Count Converted Decimal	Scan Count expressed in decimal. It indicates the position of the scan line. Scan count - Set line No. = the line position in image.
11-12	1*2	West Horizon Point	Earth Edge Position of west side at the line in S-VISSR image. Pixel count of IR1 data at the Earth edge (12 bit binary) In case the edge can't be detected or Q/D Error :$FFFF_{(16)}$ (MSB :11th word-b4,LSB :12th word-b1)
13-14	1*2	East Horizon Point	Earth Edge Position of east side at the line in S-VISSR image. Pixel count of IR data at the Earth edge (12 bit binary) In case the edge can't be detected or Q/D Error : $FFFF_{(16)}$ (MSB :13th word-b4, LSB :14th word-b1)
15	1*1	Sync lock Q/D Error information of this S-VISSR line $00_{(16)}$ Normal $FF_{(16)}$ Error	This item indicates the error information of the line. It depends on “Bit Error Count” (Line quality).
16-17	1*2	Bit Error Count Data quality of this line (12 bit binary).	This item indicates the estimated line quality of the S-VISSR line. Line quality bad $FFFF_{(16)}$ (MSB :16th word-b4, LSB :17th word-b1).
18-19	BCD*2	Year	Observation time of current line (0000～9999).

Table 8 (continued)

Word No.	Type	Contents	Description
20 21 22	BCD*1	Month Day Hour	Observation month of current line (01～12) Observation day of current line (01～31) Observation hour of current line (00～23)
23 24 25	BCD*1	Minute Second 1/100 second	Observation minute of current line (00～59) Observation second of current line (00～59) Observation 1/100 second of current line (00～99)
26-27	1*2	Calibration Table ID (16bit binary)	Version Number of Calibration Table. (MSB: 26 word-b8, LSB: 27word-b1)
28-29	1*2	MANAM Revision Number (16bit binary)	Revision Number of MANAM data which contains 1 week distribution schedule. (MSB: 28 word-b8, LSB: 29word-b1)
30	1*1	Data Source	Type of the data which is used for creating the S-VISSR image. $FF_{(16)}$ Operation Data; $00_{(16)}$ Test Data
31	1*1	Electrometer 1	
32	1*1	Electrometer 2	
33-64		Spare	
65	I*1	Scanner Select	Type of the scanner which is used for observing the data. $FF_{(16)}$ Mirror –1-A, $F0_{(16)}$ Mirror-1-B $00_{(16)}$ Mirror –2-A, $0F_{(16)}$ Mirror-2-B
66-67	I*2	Scan Count(2) (12bit binary)	The same content as of Scan count(1) but in different format. Q/D Error $FFFF_{(16)}$; (MSB: 66 word-b4,LSB: 67word-b1)

Table 8 (continued)

Word No.	Type	Contents	Description
68	I*1	Sensor Select b_8〜b_1 are set the detector type: 1: Primary sensor 0: Redundant sensor	Type of sensor used in observation. Sensor type is set into the following bits. b_8: VIS4 b_7: VIS3 b_6: VIS2 b_5: VIS1 b_4: IR4 b_3: IR3 b_2: IR2 b_1: IR1
69	I*1	Sensor Patch	Fixed value Indicates which VIS sensor's data is inserted in each VIS position. V4 in b8 b7: V1= “11” V3 in b6 b5: V3= “10” V2 in b4 b3: V2= “01” V1 in b2 b1: V1= “00”
70-72	I*3	Beta Count	β value in micro rad (24 bit binary) when the line is observed. It is calculated from the direction of Yaw-axis by reference with 20MHz clock. (MSB: 70 word-b8, LSB: 72 word-b1)

Table 8 (continued)

Word No.	Type	Contents	Description
73-75	I*3	Spin Period Count	Spin period calculated by reference clock in 24-bit binary.
76-78	I*3	Scan SYNC Detect Angle = 0 (Fixed) Q/D Error: $FFFFFF_{(16)}$	Difference between predicted and detected line SYNC counted by reference 20 MHz clock. Fixed value (Except/Q/D error). 24 bit binary.
79-81	I*3	S/C Clock=0(Fixed) Q/D Error: $FFFFFF_{(16)}$	Bit rate of downlink raw VISSR data, calculated by reference clock. 24 bit binary. Fixed value (Except/Q/D error)
82-84	I*3	Earth Pulse Angle(1) Angle at the Leading Edge of Earth Pulse=0(Fixed) Q/D Error: $FFFFFF_{(16)}$	Difference between predicted solar pulse and calculated earth pulse at the leading edge. Expressed in 24-bit binary. Fixed value (Except/Q/D error).
85-87	I*3	Earth Pulse Angle(2) Angle at the Trailing Edge of Earth Pulse=0(Fixed) Q/D Error: $FFFFFF_{(16)}$	Difference between predicted solar pulse and calculated earth pulse at the trailing edge. Expressed in 24-bit binary. Fixed value (Except/Q/D error).
88	I*1	Resembling mode	Interpolating method of resembling the raw data. b_8: “1”= nearest neighboring value b_7: “1”= linear interpolation b_6: “1”= cubic convolution b_5-b_1: always “0”
89	I*1	DPL Status	Working mode of Spin Tracking Loop and DPL bandwidth. (to be cont’d in next page)

Table 8 (continued)

Word No.	Type	Contents	Description
89	I*1		$b_8b_7b_6b_5$=X : time constant $b_4b_3b_2b_1$ =Y Y=1, SSD tracking (auto) Y=2, Analog Sun pulse tracking (auto) Y=3, Earth pulse tracking (auto) Y=4, SSD tracking (manual) Y=5, Analog Sun tracking (manual) Y=6, Earth pulse tracking (manual)
90	I*1	S/C ID Satellite ID Number (8 bit binary)	Distinction of satellite
91-93	I*3	Analog Sun Pulse Angle Analog Sun Pulse Angle 0 (Fixed) Q/D Error: $FFFFFF_{(16)}$	Difference between predicted accurate Sun pulse and detected accurate Sun pulse counted by reference clock. In 24 bit binary. Fixed value (Except Q/D error).
94-96	I*3	DPL Error	Tracking error of spin tracking loop counted by reference clock. In 24 bit binary.
97	I*1	Scanner Expanded Mode	$00_{(16)}$: normal $F0_{(16)}$: northward expansion $0F_{(16)}$: southward expansion
98	I*1	Bit and Frame SYNC ID	b_1= "0" Raw data reception finish normally b_2= "0" Scan line and frame SYNC locked

Table 8 (continued)

Word No.	Type	Contents	Description
99	I*1	Navigation information updating flag	This flag is used for the identification of navigation information (orbit/attitude data block and simplified mapping block 2). $00_{(16)}$: The navigation data predicted with earlier 24 hour observation data. $0F_{(16)}$: The navigation data predicted with earlier 6 hour observation data. $FF_{(16)}$: The navigation data predicted with earlier 1 hour data.
100-106	BCD*7	Navigation information updating time	YYYYMMDDHHmmss
107-108	I*2	Scan Line Count	Filled by ground station. Starting from effective image frame.
109-110	I*2	Focusing Criterion	
111-126		Spare	Filled with $00_{(16)}$

Table 9 Constants block (64 words)

Word No.	Type	Contents	Description
1-4	I*	Earth Radius (m): Equatorial Radius of the Earth=6378137 m	WGS-84 standard
5-8	I*	Nominal Satellite Elevation (m)	WGS-84 standard
9-12	I*	Stepping Angle for IR sensor ($10^{-3}\mu$ rad)	
13-16	I*	Sampling Angle for IR sensor (10^{-3} μ rad)	
17-20	I*	Latitude of Sub-satellite Point (m DEG)	
21-24	I*	Longitude of Sub-satellite Point (m DEG)	
25-28	I*	IR 1 Line Number of Sub-satellite Point	
29-32	I*	IR 1 Pixel Number of Sub-satellite Point	
33-36	R*4.7	Ratio of Circumference	
37-40	R*4.2	Sensor Mis-registration for Line Number (X_1) $L_{VIS}=(L_{IR1}-1)\times 4 - 2.5 + X_1$ L_{VIS} : line number of VIS sensor	Parameter for channel alignment to IR1. L_{IR1} : line number of IR1 sensor P_{IR1} : Pixel number of IR1 sensor
41-44	R*4.2	Sensor Mis-registration for Pixel Number (Y_1) $P_{VIS}=(P_{IR1}-1)\times 4 - 2.5 + Y_1$ P_{VIS} : Pixel number of VIS sensor	
45-48	R*4.2	Sensor Mis -registration for Line Number (X_2) $L_{IR2}=L_{IR1}+X_2$ L_{IR2}=line number of IR2 sensor	
49-52	R*4.2	Sensor Mis -registration for Pixel Number (Y_2) $P_{IR2}=P_{IR1}+Y_2$ P_{IR2}=Pixel number of IR2 sensor	
53-56	R*4.2	Sensor Mis-registration for Line Number (X_3): $L_{IR3}= L_{IR1}+X_3$ L_{IR3}: line number of WV sensor	
57-60	R*4.2	Sensor Mis-registration for Pixel Number (Y_3) $P_{IR3}= P_{IR1}+Y_3$ P_{IR3}: Pixel number of WV sensor	
61-64	R*4.6	Inverse of earth oblateness = 298.257223563	WGS-84 standard

Table 10. Repeat transmission of Sub-commutation block

<table>
<tr><th rowspan="3">Scan line count</th><th colspan="4">Sub-commutation block</th><th colspan="2">Repeated data blocks</th></tr>
<tr><th>193rd byte</th><th>194th byte</th><th>195th byte</th><th>196th byte</th><th colspan="2" rowspan="2">197th byte
～
1090th byte</th></tr>
<tr><th>Set “0”</th><th>Sequential sub-commutation ID (0-24)</th><th>Set “0”</th><th>repeated data counter (0-7)</th></tr>
<tr><td>N+1</td><td>0</td><td>0</td><td>0</td><td>0</td><td rowspan="8">The first data group to be transmitted repeatedly 8 times</td><td rowspan="21">Repeated text

200 lines/ text

25 groups</td></tr>
<tr><td>N+2</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>N+3</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>N+4</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>N+5</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>N+6</td><td>0</td><td>0</td><td>0</td><td>5</td></tr>
<tr><td>N+7</td><td>0</td><td>0</td><td>0</td><td>6</td></tr>
<tr><td>N+8</td><td>0</td><td>0</td><td>0</td><td>7</td></tr>
<tr><td>N+9</td><td>0</td><td>1</td><td>0</td><td>0</td><td rowspan="5"></td></tr>
<tr><td>N+10</td><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>…..</td><td>…..</td><td>…..</td><td>…..</td><td>…..</td></tr>
<tr><td>N+191</td><td>0</td><td>23</td><td>0</td><td>6</td></tr>
<tr><td>N+192</td><td>0</td><td>23</td><td>0</td><td>7</td></tr>
<tr><td>N+193</td><td>0</td><td>24</td><td>0</td><td>0</td><td rowspan="8">The 25th data group to be transmitted repeatedly 8 times</td></tr>
<tr><td>N+194</td><td>0</td><td>24</td><td>0</td><td>1</td></tr>
<tr><td>N+195</td><td>0</td><td>24</td><td>0</td><td>2</td></tr>
<tr><td>N+196</td><td>0</td><td>24</td><td>0</td><td>3</td></tr>
<tr><td>N+197</td><td>0</td><td>24</td><td>0</td><td>4</td></tr>
<tr><td>N+198</td><td>0</td><td>24</td><td>0</td><td>5</td></tr>
<tr><td>N+199</td><td>0</td><td>24</td><td>0</td><td>6</td></tr>
<tr><td>N+200</td><td>0</td><td>24</td><td>0</td><td>7</td></tr>
</table>

Table 11 Simplified mapping block (2500 words)

Word	Type	Contents
1,2	I*2	Line number of 60° N, 45° E
3,4	I*2	Pixel number of 60° N, 45° E
5,6	I*2	Line number of 60° N, 50° E
7,8	I*2	Pixel number of 60° N, 50° E
…	…	…
101,102	I*2	Line number of 55° N, 45° E
103,104	I*2	Pixel number of 55° N, 45° E
105,106	I*2	Line number of 55° N, 50° E
107,108	I*2	Pixel number of 55° N, 50° E
…	…	…
2493,2494	I*2	Line number of 60° S, 165° E
2495,2496	I*2	Pixel number of 60° S, 165° E
2497,2498	I*2	Line number of 60° S, 165° E
2499,2500	I*2	Pixel number of 60° S, 165° E

Table 12 Orbit and attitude data block (3200 words)

Word No.	Type	Contents	Description
1-6	R*6.8	Observation start time (MJD)	
7-10	R*4.8	VIS channel Stepping Angle along line (rad)	
11-14	R*4.8	IR channel Stepping Angle along line(rad)	
15-18	R*4.10	VIS channel Sampling Angle along pixel (rad)	
19-22	R*4.10	IR channel Sampling Angle along pixel(rad)	
23-26	R*4.4	VIS channel centre line number of VISSR frame	
27-30	R*4.4	IR1 channel centre line number of VISSR frame	
31-34	R*4.4	VIS channel centre pixel number of VISSR frame	
35-38	R*4.4	IR1 channel centre pixel number of VISSR frame	
39-42	R*4.0	Number of Sensors of VIS channel	
43-46	R*4.0	Number of Sensors of IR channel	
47-50	R*4.0	VIS total line number of VISSR frame	
51-54	R*4.0	IR total line number of VISSR frame	
55-58	R*4.0	VIS pixel number of one line	
59-62	R*4.0	IR pixel number of one line	
63-66	R*4.10	VISSR misalignment angle around x-axis(rad)	
67-70	R*4.10	VISSR misalignment angle around y-axis(rad)	
71-74	R*4.10	VISSR misalignment angle around z-axis(rad)	

Table 12 (Continued)

Word No.	Type	Contents	Description
75-78	R*4.7	Element of VISSR misalignment matrix on row 1 and column 1	Fixed value
79-82	R*4.10	row 2 and column 1	
83-86	R*4.10	row 3 and column 1	
87-90	R*4.10	row 1 and column 2	
91-94	R*4.7	row 2 and column 2	
95-98	R*4.10	row 3 and column 2	
99-102	R*4.10	row 1 and column 3	
103-106	R*4.10	row 2 and column 3	
107-110	R*4.7	row 3 and column 3	
111-114	R*4.4	IR2 channel centre line number of VISSR frame	
115-118	R*4.4	IR3 channel centre line number of VISSR frame	
119-122	R*4.4	IR2 channel centre line number of VISSR frame	
123-126	R*4.4	IR3 channel centre line number of VISSR frame	
127-128		Spare	
129-132	R*4.7	Constants-Ratio of Circumference	Ratio of Circumference π（Fixed value)
133-136	R*4.9	-Ratio of Circumference/180	π/180（Fixed value）
137-140	R*4.6	-180/Ratio of Circumference	180/π （Fixed value）
141-144	R*4.1	-Equatorial Radius of the Earth(m)	Equatorial Radius of the Earth (Fixed value)
145-148	R*4.10	-Oblateness of the Earth	Oblateness of the Earth (Fixed value)
149-152	R*4.9	-Eccentricity of the Earth	Eccentricity of the Earth (Fixed value)
153-156	R*4.8	-Angle between the VISSR and the View Direction of the Sun Sensor (rad)	Angle of Data acquisition start (Fixed value)

Table 12 (Continued)

Word No.	Type	Contents	
157-162	R*6.8	-Epoch Time of Orbital Parameters (MJD)	Orbit parameters in the mean J2000.0 coordinate system
163-168	R*6.8	-Semi-major Axis (km)	
169-174	R*6.10	-Eccentricity	
175-180	R*6.8	-Inclination (deg)	
181-186	R*6.8	-Longitude of Ascending Node (deg)	
187-192	R*6.8	-Argument of Perigee (deg)	
193-198	R*6.8	-Mean Anomaly (deg)	
199-204	R*6.6	-Sub-satellite East Longitude (deg)	
205-210	R*6.6	-Sub-satellite North Latitude (deg)	
211-216	R*6.8	-Epoch Time of Attitude parameters (MJD)	Attitude parameters in the mean J2000.0 coordinate system
217-222	R*6.8	-Angle between Z-axis and Satellite Spin Axis projected on yz-plane α_r(rad)	
223-228	R*6.15	-Change-rate of α_r(rad/sec)	
229-234	R*6.11	-Angle between Satellite Spin Axis and yz-plane δ_r(rad)	
235-240	R*6.15	-Change-rate of δ_r(rad/sec)	
241-246	R*6.8	-Daily Mean of Satellite Spin Rate (rpm)	Value (Estimated) of Spin Rate
247-256		Spare	

Table 12 (Continued)

Word No.	Type	Contents	Description
257-896		Attitude Prediction Data Sub-blocks 1 through 10 (10 similar attitude prediction data sub-blocks are repeated-for details see Table 9)	Please refer to Table 9
897-2944		Orbit Prediction Data Sub-blocks 1 through 8 (8 similar orbit prediction data sub-blocks are repeated-for details see Table 10)	Please refer to Table 10
2945-2950	R*6.8	Time of the First Attitude Prediction Data(MJD)	Time of the first attitude prediction record(Attitude Prediction Data Block)
2951-2956	R*6.8	Time of the Last Attitude Prediction Data(MJD)	Time of the Last attitude prediction record(Attitude Prediction Data Block)
2957-2962	R*6.8	Interval Time of Attitude Prediction Data(MJD)	Fixed value (0.00347222)
2963-2964	I*2	Number of Attitude Prediction Data	Number of Attitude Prediction Data Block(=10)
2965-2970	R*6.8	Time of the First Orbital Prediction Data(MJD)	Time of the first orbit prediction record (Orbit prediction Data Block)
2971-2976	R*6.8	Time of the Last Attitude Prediction Data(MJD)	Time of the last orbit prediction record (Orbit prediction Data Block)
2977-2982	R*6.8	Interval Time of Orbital Prediction Data(MJD)	Fixed value (0.00347222)
2983-2984	I*2	Number of Orbit Prediction Data	Number of Orbit Prediction Data Block(=8)
2985-3200		Spare	

Table 13 Contents of attitude prediction data sub-block (64-words)

Word No.	Type	Contents	Description
1-6	R*6.8	Prediction time(UTC represented in MJD)	Time (UTC)when the attitude prediction is processed.
7-12	BCD*6	Anno Domini represented by BCD YY year (00～99) MM month (01～12) DD day (01～31) HH hour (00～23) mm minute (00～59) ss second (00～59)	Time when the attitude prediction is processed. It is expressed by BCD.
13-18	R*6.8	Angle between z-axis and satellite spin axis projected on yz-plane in mean of 1950.0 coordinates (rad)	In the mean J2000.0 coordinate system
19-24	R*6.11	Angle between satellite spin axis and yz-plane (rad)	
25-30	R*6.8	Dihedral Angle between the Sun and the Earth measured clockwise viewing from North (rad)	
31-36	R*6.8	Spin Rate: spin speed of satellite (rpm)	
37-42	R*6.8	Right Ascension of satellite spin axis (rad)	On the Satellite Orbit Plane Coordinate System
43-48	R*6.8	Declination of satellite spin axis (rad)	
49-64		Spare	

Table 14 Contents of orbit prediction data sub-block (256 words)

Word No.	Type	Contents (position means a relative address in the block)
1-6	R*6.8	Prediction time (UTC represented in MJD)
7-12	BCD*6	Anno Domini represented by BCD (YYMMDDHHmmss; Year, Month, Day, Hour, Minute, Second)
13-18	R*6.6	X component of satellite position in the mean J2000.0 coordinates(m)
19-24	R*6.6	Y component of satellite position in the mean J2000.0 coordinates(m)
25-30	R*6.6	Z component of satellite position in the mean J2000.0 coordinates(m)
31-36	R*6.8	X component of satellite position in the mean J2000.0 coordinates(m/s)
37-42	R*6.8	Y component of satellite position in the mean J2000.0 coordinates(m/s)
43-48	R*6.8	Z component of satellite position in the mean J2000.0 coordinates(m/s)
49-54	R*6.6	X component of satellite position in the earth-fixed coordinates(m)
55-60	R*6.6	Y component of satellite position in the earth-fixed coordinates(m)
61-66	R*6.6	Z component of satellite position in the earth-fixed coordinates(m)
67-72	R*6.10	X component of satellite position in the earth-fixed coordinates(m/s)
73-78	R*6.10	Y component of satellite position in the earth-fixed coordinates(m/s)
79-84	R*6.10	Z component of satellite position in the earth-fixed coordinates(m/s)
85-90	R*6.8	Greenwich sidereal time in true of data coordinates(deg)
91-96	R*6.8	Right ascension from the satellite to the sun in mean of J2000.0 coordinates(deg)
97-102	R*6.8	Declination from the satellite to the sun in mean of J2000.0 coordinates(deg)
103-108	R*6.8	Right ascension from the satellite to the sun in the earth-fixed coordinates(deg)
109-114	R*6.8	Declination from the satellite to the sun in the earth-fixed coordinates(deg)
115-128		Spare
129-134	R*6.12	Nutation and precession matrix row 1 and column 1
135-140	R*6.14	row 2 and column 1
141-146	R*6.14	row 3 and column 1
147-152	R*6.14	row 1 and column 2
153-158	R*6.12	row 2 and column 2
159-164	R*6.16	row 3 and column 2
165-170	R*6.12	row 1 and column 3
171-176	R*6.16	row 2 and column 3
177-182	R*6.12	row 3 and column 3
183-188	R*6.8	Sub-satellite Point: North Latitude (deg)
189-194	R*6.8	Sub-satellite Point: East Longitude (deg)
195-200	R*6.6	Height of the Satellite above the Earth Surface (m)
201-256		Spare

Table 15 Calibration data block 1(6400 words)

Word No.	Type	Contents	Description
1-4	I*4	Calibration information ID	
5-10	BCD*6	Data generated date	(YYYY.MM.DD.HH.mm)
11	I*1	Sensor selection	1-primary sensor, 2-backup sensor
12-256		Spare	
257-512	R*4.6×64	VIS1 level-albedo conversion table	257-260 albedo of 0 level 261-264 albedo of 1 level 265-268 albedo of 2 level ⋮ ⋮ ⋮ 509-512 albedo of 63 level
513-768	R*4.6×64	Same above but VIS2	Same as above but position
769-1024	R*4.6×64	Same above but VIS3	Same as above but position
1025-1280	R*4.6×64	Same above but VIS4	Same as above but position
1281-2304	R*4.3×256	IR1 Level-temperature conversion table	1281-1284 temperature of 0 level(K) 1285-1288 temperature of 1 level(K) ⋮ ⋮ ⋮ 2301-2304 temperature of 1023 level(K)
2304-3328	R*4.3×256	Same as above but IR2	Same as above but position
3329-4352	R*4.3×256	Same as above but IR3	Same as above but position
4352-5376	R*4.3×256	Same as above but IR4	Same as above but position
5377-6400		Spare	

Table 16 Calibration data block 2(25600 words)

Word No.	Type	Contents	Description
1-4	I*4	Calibration information ID	
5-10	BCD*6	Data generated date	(YYYY.MM.DD.HH.mm)
11	I*1	Sensor selection	1-primary sensor, 2-backup sensor
12-256		Spare	
257-512	R*4.6×64	VIS1 level-albedo conversion table	257-260 albedo of 0 level 261-264 albedo of 1 level 265-268 albedo of 2 level . . . . 509-512 albedo of 63 level
513-768	R*4.6×64	Same above but VIS2	Same as above but position
769-1024	R*4.6×64	Same above but VIS3	Same as above but position
1025-1280	R*4.6×64	Same above but VIS4	Same as above but position
1281-5376	R*4.3×1024	IR1 Level-temperature conversion table	1281-1284 temperature of 0 level(K) 1285-1288 temperature of 1 level(K) . . . . 5372-5375 temperature of 1023 level(K)
5377-9472	R*4.3×1024	Same as above but IR2	Same as above but position
9473-13568	R*4.3×1024	Same as above but IR3	Same as above but position
13569-17664	R*4.3×1024	Same as above but IR4	Same as above but position
17665-25600		Spare	

3.2.2 Infrared Image Data Sectors

The sector 2～4 and sector 9～12 are infrared image data sectors. Each infrared sector includes 2,291 pixels as one line of image data. The spatial resolution of the IR pixel is 5 km at the sub-satellite point. Quantization of IR channels are expressed using 10 bits but upper 8 bits in the IR1～IR3 data are provided in the sectors 2～4 to maintain compatibility with FY-2B S-VISSR. The lower 2 bits of IR1～IR3 data are provided in the sectors 9～11. Users can combine them to recover the complete pixel data. The IR4 data are provided in the sector 12.

The IR sector ID codes and IR image data are defined in Table 17.

Table 17. The IR sector ID code

Sector	ID code word 1	ID code word 2
IR1(upper 8 bits data)	00010001	00010001
IR2(upper 8 bits data)	00100010	00100010
IR3(upper 8 bits data)	01000100	01000100
IR1(lower 2 bits data)	10001000	10001000
IR2(lower 2 bits data)	10011001	10011001
IR3(lower 2 bits data)	10101010	10101010
IR4(10 bits data)	10111011	10111011

3.2.3 Visible Image Data Sector

Sector 5～8 are visible image data sectors. The observation band is 0.55-0.90 µm. The spatial resolution is 1.25km at the sub-satellite point. The visible image is observed with 4 parallel scanning sensors, thus obtaining four lines by one scan. Each line includes 9164 pixels. Quantization of VIS channel is expressed using 6 bits.

The sector ID codes are defined in Table 18.

Table 18. Definition of visible image data sector ID codes

Sensor	ID code word 1	ID code word 2
VIS1	011011	011011
VIS2	101101	101101
VIS3	110110	110110
VIS4	111111	111111

3.3 Dummy Data

Each scan acquires a set of observation data including 4 lines of visible channel data, one line of 4 IR channels data. These observational data and documentation data are put into the S-VISSR2.0 format to be transmitted as S-VISSR image data stream. The data stream of one scan line contains 364848 bits and transmitted at 660Kbps, beginning with the 10000-bit SYNC code, and ends with PN code whose length is variable with the change of the spin cycle of the satellite.

4. Coding method

Two stages of coding scheme in 4.1 and 4.2 are applied to S-VISSR data transmission for the purpose of RF energy distribution and maintaining sycn-lock of MDUS demodulation which may lose sync-lock on incoming data when logic ones and zeros continue.

4.1 Byte Complementing

The first stage of coding is the byte complementing. It starts at the beginning of the information sectors. Every other 8 bits of the original S-VISSR data are inverted (complemented every even byte). It continues down to the end of Dummy data. Note that the byte complement is not applied to SYNC code.

4.2 PN Scrambling

The second stage of coding is PN scrambling. It involves the entire S-VISSR image data stream including the SYNC code. Byte complemented S-VISSR data stream and the output of PN code generator are scrambled into an exclusive OR gate before DPSK modulation at CDAS for dissemination.

At the user end, the received data needs to be demodulated. The received data and the output of local PN code generator are sent into another OR gate. The process is so called de-scrambling. The de-scrambling schematic of PN coded S-VISSR data is described in Figure 1.

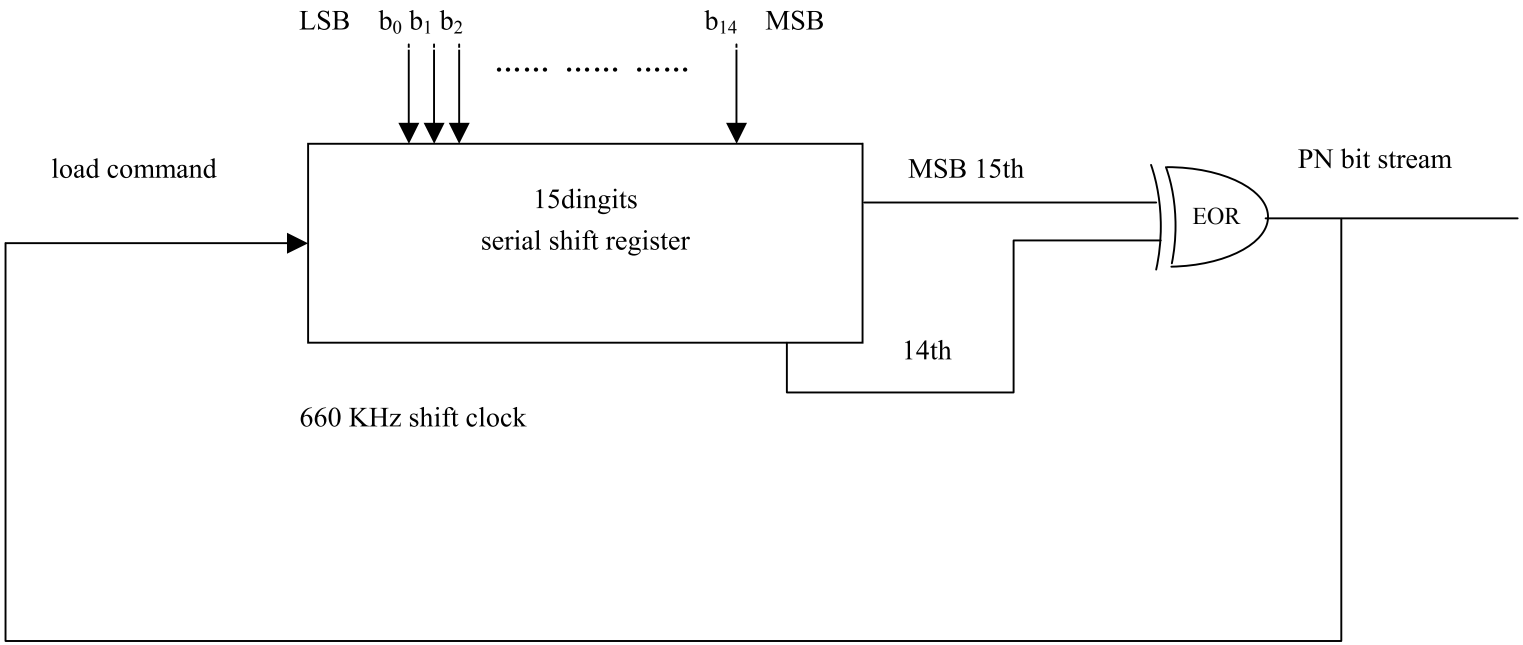

Figure 1   PN pattern generator

5. Note for the Types of S-VISSR Data Used in Tables 4～6 and 8～11

5.1 R*n.m

The value is expressed by n-bytes (n*8 bits) binary number, the first bit (MSB) defines the sign of it; “0” means plus and “1”means minus. The number m means that the binary number should be multiplied by 10^{-m} to get the value.

Example:

MSB LSB
R*4.0; 00000000 00000000 00000111 10110101=1973
R*4.2; 00000000 00000000 00000111 10110101=1973*10^{-2}=19.73
R*4.5; 10000000 00000000 00000111 10110101=-1973*10^{-5}= -0.01973

MSB LSB
R*2.0; 10101101 10011100 =-11676

In the example, MSB means the first bit, LSB means the last bit.

5.2 I*n:

The value is expressed by n binary integer (n* 8-bits). The first bit (MSB) defines the sign of binary integer; ‘0” means plus and “1” means minus. In the case of negative number, the other bits show the complement number that is added 1.

Example:

MSB LSB
I*2; 00101101 1001100=19999
I*2; 10101101 10011100=(-1)*(0101101 10011100 minus 1 and be complemented)
=(-1)*(1010010 01100100)
=-21092

5.3 BCD*n

The value is expressed by n-words (n*8-bits) with 4-bits binary coded decimals.

Example:

BCD*2; 1001 0111 0110 0101=9765
“9” “7” “6” “5”

Annex-1

The Observing Scope of FY-2C/D/E Satellite at 105^{o} E

Annex-2
Definition of FY-2C/D/E Regional Scanning Modes

Definition (hexadecimal)	Scan range	Note
01	10~1400	
02	1200~2500	
03	250~1050	
04	1450~2250	
05	600~1300	
06	1200~1900	
07	200~ 650	
08	1850~2300	
09	450~1500	
0A	1000~2050	
0B	400~ 850	
0C	1650~2100	
0D	600~1900	
0E	450~1050	
0F	1500~2050	

Annex-3
Example of MANAM in normal operation mode

MANAM OF FY-2C STRETCHED VISSR SCHEDULE (Sep-May)

FROM 12 Jan.,2005 TO 18 Jan.,2005

NATIONAL SATELLITE METEOROLOGICAL CENTER (BEIJING,CHINA)

TIME(UTC)	VISSR	12	13	14	15	16	17	18	COMMENTS
0000 - 0026	V-0 F	0	0	0	0	0	0	0	
0100 - 0126	V-1 F	0	0	0	0	0	0	0	
0200 - 0226	V-2 F	0	0	0	0	0	0	0	
0300 - 0326	V-3 F	0	0	0	0	0	0	0	
0400 - 0426	V-4 F	0	0	0	0	0	0	0	
0456 - 0522	V-5 F	0	0	0	0	0	0	0	
0529 - 0555	V-6 W	0	0	0	0	0	0	0	
0600 - 0626	V-7 F	0	0	0	M	0	0	0	
0700 - 0726	V-8 F	0	0	0	M	0	0	0	
0800 - 0826	V-9 F	0	0	0	M	0	0	0	
0900 - 0926	V-10 F	0	0	0	M	0	0	0	
1000 - 1026	V-11 F	0	0	0	0	0	0	0	
1056 - 1122	V-12 F	0	0	0	0	0	0	0	

1129 - 1155	V-13 W	0	0	0	0	0	0	0	
1200 - 1226	V-14 F	0	0	0	0	0	0	0	
1300 - 1326	V-15 F	0	0	0	0	0	0	0	
1400 - 1426	V-16 F	0	0	0	0	0	0	0	
1500 - 1526	V-17 F	0	0	0	0	0	0	0	
1600 - 1626	V-18 F	0	0	0	0	0	0	0	
1656 - 1722	V-19 F	0	0	0	0	0	0	0	
1729 - 1755	V-20 W	0	0	0	0	0	0	0	
1800 - 1826	V-21 F	0	0	0	0	0	0	0	
1900 - 1926	V-22 F	0	0	0	0	0	0	0	
2000 - 2026	V-23 F	0	0	0	0	0	0	0	
2100 - 2126	V-24 F	0	0	0	0	0	0	0	
2200 - 2226	V-25 F	0	0	0	0	0	0	0	
2256 - 2322	V-26 F	0	0	0	0	0	0	0	
2329 - 2355	V-27 W	0	0	0	0	0	0	0	

ABBREVIATION:

V=VISSR	S=SINGLE LINE SCAN
W=WIND OBSERVATION	O=OPERATION
F=FULL DISK OBSERVATION	M=MAINTENACE
N=NORTH DISK OBSERVATION	E=ECLIPSE
A=AREA OBSERVATION	P=SOLAR DIRECT SHINE PROTECT

Annex-4
Example of MANAM in flooding season mode

MANAM OF FY-2C STRETCHED VISSR SCHEDULE (Jun-Aug)

FROM 12 Jul.,2005 TO 18 Jul.,2005

NATIONAL SATELLITE METEOROLOGICAL CENTER (BEIJING,CHINA)

TIME(UTC)	VISSR	12	13	14	15	16	17	18	COMMENTS
0000 - 0026	V-0 F	0	0	0	0	0	0	0	
0033 - 0047	V-1 N	0	0	0	0	0	0	0	
0100 - 0126	V-2 F	0	0	0	0	0	0	0	
0133 - 0147	V-3 N	0	0	0	0	0	0	0	
0200 - 0226	V-4 F	0	0	0	0	0	0	0	
0233 - 0247	V-5 N	0	0	0	0	0	0	0	
0300 - 0326	V-6 F	0	0	0	0	0	0	0	
0333 - 0347	V-7 N	0	0	0	0	0	0	0	
0400 - 0426	V-8 F	0	0	0	0	0	0	0	
0433 - 0447	V-9 N	0	0	0	0	0	0	0	
0456 - 0522	V-10 F	0	0	0	0	0	0	0	
0529 - 0555	V-11 W	0	0	0	0	0	0	0	
0600 - 0626	V-12 F	0	0	0	M	0	0	0	
0633 - 0647	V-13 N	0	0	0	M	0	0	0	
0700 - 0726	V-14 F	0	0	0	M	0	0	0	

0733 - 0747	V-15 N	0	0	0	M	0	0	0	
0800 - 0826	V-16 F	0	0	0	M	0	0	0	
0833 - 0847	V-17 N	0	0	0	M	0	0	0	
0900 - 0926	V-18 F	0	0	0	M	0	0	0	
0933 - 0947	V-19 N	0	0	0	M	0	0	0	
1000 - 1026	V-20 F	0	0	0	0	0	0	0	
1033 - 1047	V-21 N	0	0	0	0	0	0	0	
1056 - 1122	V-22 F	0	0	0	0	0	0	0	
1129 - 1155	V-23 W	0	0	0	0	0	0	0	
1200 - 1226	V-24 F	0	0	0	0	0	0	0	
1233 - 1247	V-25 N	0	0	0	0	0	0	0	
1300 - 1326	V-26 F	0	0	0	0	0	0	0	
1333 - 1347	V-27 N	0	0	0	0	0	0	0	
1400 - 1426	V-28 F	0	0	0	0	0	0	0	
1433 - 1447	V-29 N	0	0	0	0	0	0	0	
1500 - 1526	V-30 F	0	0	0	0	0	0	0	
1533 - 1547	V-31 N	0	0	0	0	0	0	0	
1600 - 1626	V-32 F	0	0	0	0	0	0	0	
1633 - 1647	V-33 N	0	0	0	0	0	0	0	
1656 - 1722	V-34 F	0	0	0	0	0	0	0	
1729 - 1755	V-35 W	0	0	0	0	0	0	0	
1800 - 1826	V-36 F	0	0	0	0	0	0	0	

1833 - 1847	V-37 N	0	0	0	0	0	0	0	
1900 - 1926	V-38 F	0	0	0	0	0	0	0	
1933 - 1947	V-39 N	0	0	0	0	0	0	0	
2000 - 2026	V-40 F	0	0	0	0	0	0	0	
2033 - 2047	V-41 N	0	0	0	0	0	0	0	
2100 - 2126	V-42 F	0	0	0	0	0	0	0	
2133 - 2147	V-43 N	0	0	0	0	0	0	0	
2200 - 2226	V-44 F	0	0	0	0	0	0	0	
2233 - 2247	V-45 N	0	0	0	0	0	0	0	
2256 - 2322	V-46 F	0	0	0	0	0	0	0	
2329 - 2355	V-47 W	0	0	0	0	0	0	0	

ABBREVIATION:

V=VISSR	S=SINGLE LINE SCAN
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