FY-3 Satellites to Ground Interface Control Document

(FY-3C have some different from FY-3A/B, please see red text)

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Content

1. Executive Summary

The FY-3 system is the second-generation polar-orbiting meteorological satellite developed by China, aboard with an array of sophisticated instruments, including VIRR (Visible-Infrared Radiometer), IRAS(Infrared Atmospheric Sounder), MWTS (Microwave Temperature Sounder), MWHS(Microwave Humidity Sounder), MERSI (Medium Resolution Spectral Imager), MWRI(Microwave Radiation Imager), Solar Backscatter Ultraviolet and Total Ozone Sounder (SBUV/TOS), ERM(Earth Radiation Measurement), SIM (Solar Irradiation Monitor), and SEM (Space Environment Monitor).only FY-3C have GNOS ,The system is able to collect diverse global data, in an all-weather, three dimensional, and quantitative manner.

A FY-3 meteorological satellite transmits its payload data and telemetry parameters via three downlinks as follows:

Table 1-1 Instrument channels and corresponding downlinks

Sounders	HRPT	MPT	DPT
MERSI		√	√
VIRR	√		√
MWRI	√		√
IRAS	√		√
Ultraviolet Ozone Vertical Sounder	√		√
Ultraviolet Ozone Total Sounder	√		√
ERM	√		√
SIM	√		√
MWTS	√		√
MWHS	√		√
SEM	√		√
GNOS(ONLY FY-3C)	√		√
Telemetry parameters	√		√

(including GPS signals）			

- High Resolution Picture Transmission（HRPT）real-time data are broadcasted globally via L-Band downlinks (HRPT）;
- MERSI data are broadcasted over China area, and selected overseas areas that have an international cooperation accord, via X-Band downlinks, or MPT;

The two downlinks will transmit synchronously.

2. Transmission formats

Formats for transmitting scientific instrument data are given in Fig. 2-1, and pad frame in Fig. 2-2. FY-3 frame formats are listed in Table 2-1, and associated definitions in Table 2-2.

TABLE 2-1   FY-3 FRAME FORMATS

TABLE 2-2   DEFINITIONS OF DATA ELEMENTS

4Bytes	2Bits	8Bits	6Bits		3Bytes	1Byte	2Bytes	1012 Bytes		
								Data field		
Synchronization	Version	Aircraft	VC identifier		Counts	Playback	Insert	Pointer（2Bytes）	Data（882Bytes）	RS（128Bytes）
1A CF FC 1D	4C		MERSI　　　　VC1	43		Realtime：00 Delay：80	Encryption：FF+code Open code：00 00	MPT/HRPT：3F FF DPT：3F FF		
			VIRR （Day）VC2	45						
			VIRR （Night）VC3	49						
			MWRI　　　　VC4	4A						
			1553B VC5	4C				5bits"0"+11 bits		
			GNOS　VC6	4B						

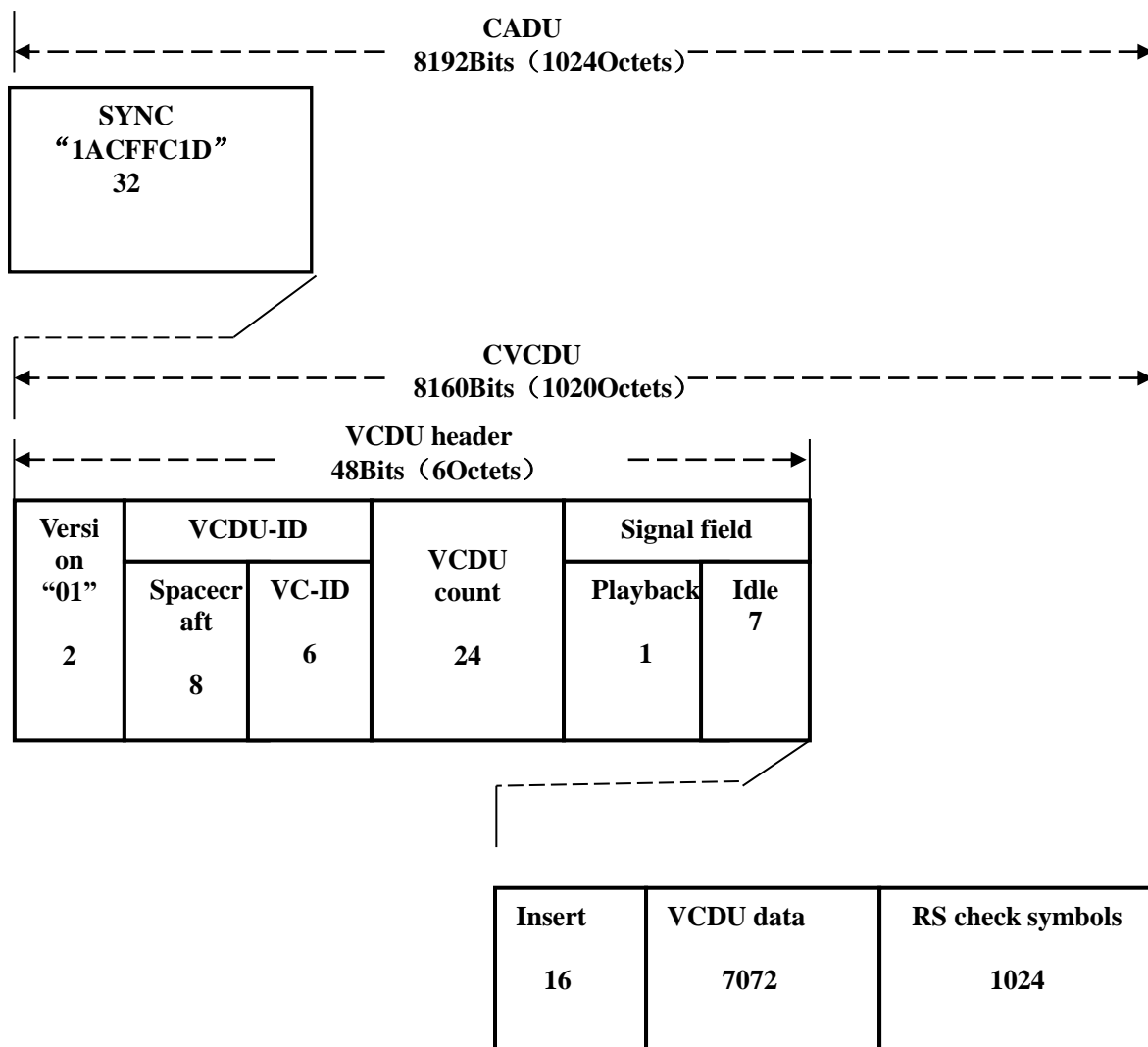| Elements	Definition	
Version	"01"B, meaning a structure defined by V. 2 CCSDS.	
Spacecraft	"00110001"B , along with VC identifier, makes a VCDU-ID	
VC-ID	A virtual channel identifier, a full "1"B for pad CADU	
VCDU count	Sequential count (modulo 16777216) of VCDUs for each virtual channel. The VCDU count of a pad CADU is a sequential count（modulo 16777216）。	
Signal field	According to CCSDS, playback is marked as "0"B, representing the real-time L/X-band VCDU; when marked as "1"B, meaning a delayed X-band VCDU; backup is marked as a full "0"B.	
Insert	Encrypted	
Backup/Header pointer	B-PDU	Backup 2bits, full "0"B，flow data pointer 14bits, full"1"B。
	M-PDU	Backup 5bits, full"0"B，11bits identifier, M-PDU header pointer。

CADU
8192Bits（1024Octets）

SYNC "1ACFFC1D" 32

CVCDU
8160Bits（1020Octets）

VCDU header
48Bits（6Octets）

Versi on "01" 2	VCDU-ID		VCDU count 24	Signal field	
	Spacecr aft 8	VC-ID 6		Playback 1	Idle 7

Insert 16	VCDU data 7072	RS check symbols 1024

Fig. 2-1 Format CADU

CADU
8192Bits（1024Octets）

SYNC
"1ACFFC1D"
32

CVCDU
8160Bits（1020Octets）

VCDU Header
48Bits（6Octets）

Ver.	VCDU-ID		VCDU count	signal field	
	Spacecraft	VC-ID		Playback	Idle
01"	"00110001"	"111111"			
2	8	6	24	1	7

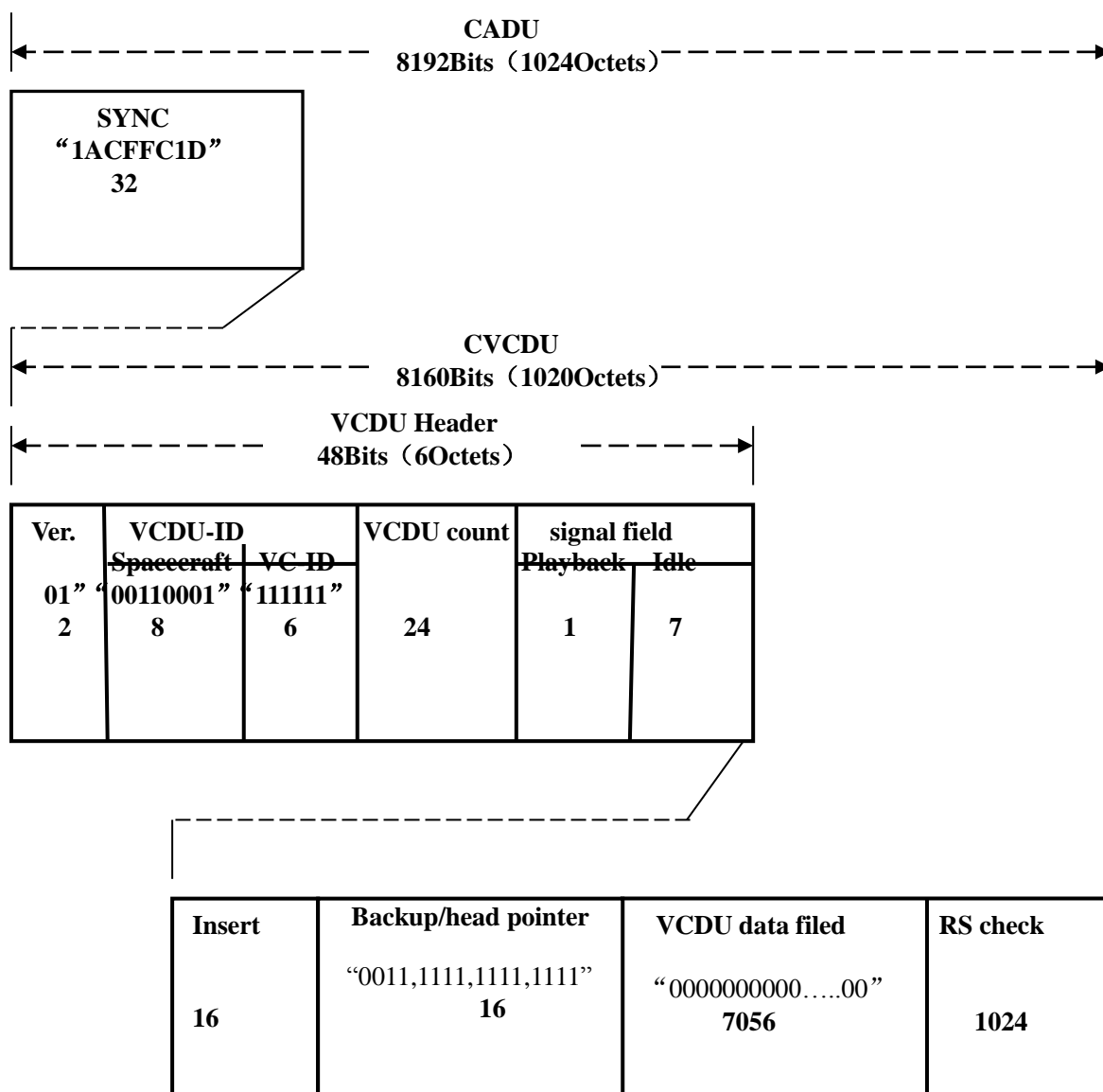| Insert	Backup/head pointer	VCDU data filed	RS check
	"0011,1111,1111,1111"	"0000000000…..00"	
16	16	7056	1024

Fig 2-2　Pad CADU format

2.1 Baseband processing

2.1.1 Scrambling

The practice is designed to ensure the timely recovery of data quality, through reducing consecutive codes of 0 or 1. The binary information shall be randomized into a pseudo randomized sequence, in an attempt to limit the length of consecutive 0 or 1. The randomization is often termed as code scrambling.

Code scrambling makes a better synchronization between clock and data. CCSDS suggests a multinomial: $F(X)=X^8+X^7+X^5+X^3+1$ for code scrambling. The sequence shall be repeated every 255bit. Re-initialization of the sequence generator shall be a full '1' status for each synchronous cycle.

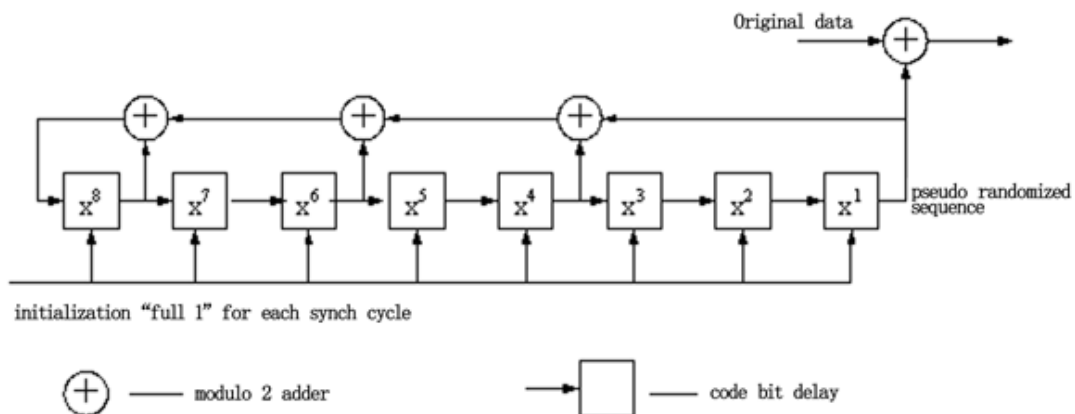The scrambling flow is given in the following diagram.

Fig. 2-3   Data scrambling flow

2.1.2 Encryption

In X-band real-time transmission, an MPT link is designed with the function to convert a translucent mode into an encrypted one. A pad encryption control is made to CADU insert. FY-3 satellite is applied with a data encryption system (DES).

3. Error correction coding

RS code (255,223), recommended by CCSDS, is used as an outer code, and convolutional code an inner code. Meanwhile, RS codes are generated with an interleaving depth of I=4.

HRPT downlink works on concatenated codes, or RS (255,223) + CONV (7,3/4), with its flow shown in Fig. 3-1.
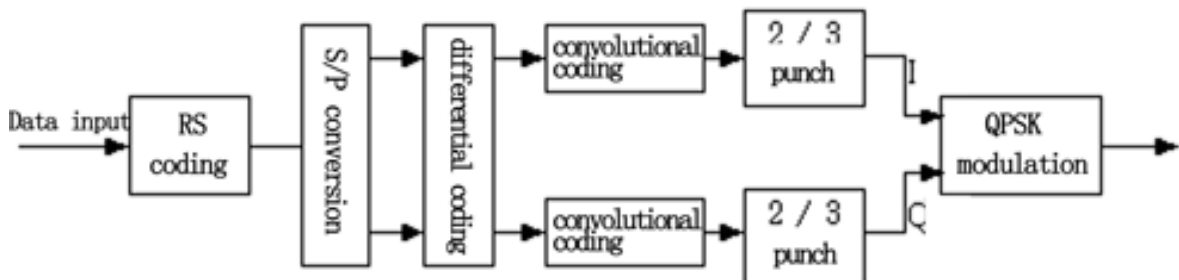

Fig. 3-1   Concatenated coding using HRPT RS (255,223)+ CONV(7,3/4)

MPT downlink operates with concatenated codes, or LACTIC ACID (255,223) +CONV(7,1/2), as shown in Fig. 3-2.
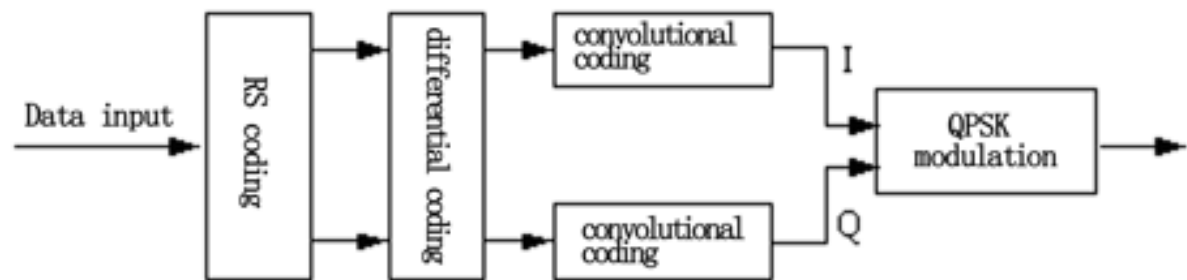

Fig. 3-2   Concatenated coding using MPT RS (255,223)+ CONV(7,1/2)

DPT downlink uses concatenated codes, or RS (255,223) + CONV (7,3/4), with its flow diagram shown in Fig. 3-3.
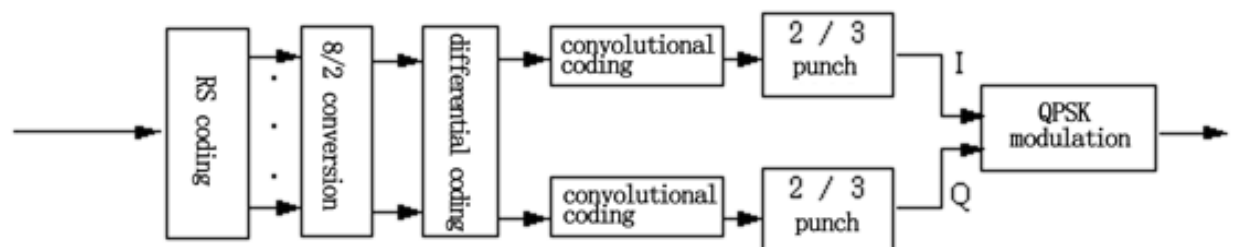

11

Fig. 3-3 Concatenated coding using DPT RS (255,223)+ CONV(7,3/4)

3.1 RS（255,223）coding

To meet the standards defined by CCSDS, RS(255,223) shall have a multinomial that is built on GF(2), or GF(2^8) as follows:

$$F(X)=X^8+X^7+X^2+X+1$$

Then, code generating multinomial is

$$g_{(x)} = \prod_{j=112}^{143}(x-\alpha^{11j}) = \sum_{i=0}^{32}G_i x^i$$

Where：α — generating cell for limited GF(2^8)

α^{11} — primitive cell for limited GF(2^8)

G_i — coefficient

RS code, derived from the above-mentioned multinomial, is a system code, which means the first 223 digits of codeword are primitive code cells, while 32 digits in the rear are the check code cells generated by information code cells.

To raise the burst error correcting capability of data transmission sub-systems, an RS code with an interleaving depth of I=4 is applied. Its flow diagram is shown in Fig. 3-4.

Input：$a_1 b_1 c_1 d_1 a_2 b_2 c_2 d_2 a_3 b_3 c_3 d_3 \ldots\ldots a_{223} b_{223} c_{223} d_{223}$；
RS encoder 1 input：$a_1 a_2 a_3 a_4 \ldots\ldots a_{223}$, output：$a_1 a_2 a_3 a_4 \ldots\ldots a_{223} A_1 A_2 \ldots\ldots A_{32}$；
RS encoder 2 input：$b_1 b_2 b_3 b_4 \ldots\ldots b_{223}$, output：$b_1 b_2 b_3 b_4 \ldots\ldots b_{223} B_1 B_2 \ldots\ldots B_{32}$；
RS encoder 3 input：$c_1 c_2 c_3 c_4 \ldots\ldots c_{223}$, output：$c_1 c_2 c_3 c_4 \ldots\ldots c_{223} C_1 C_2 \ldots\ldots C_{32}$；
RS encoder 4 input：$d_1 d_2 d_3 d_4 \ldots\ldots d_{223}$, output：$d_1 d_2 d_3 d_4 \ldots\ldots d_{223} D_1 D_2 \ldots\ldots D_{32}$；
Output：$a_1 b_1 c_1 d_1 a_2 b_2 c_2 d_2 a_3 b_3 c_3 d_3 \ldots\ldots a_{223} b_{223} c_{223} d_{223}$, $A_1 B_1 C_1 D_1 A_2 B_2$
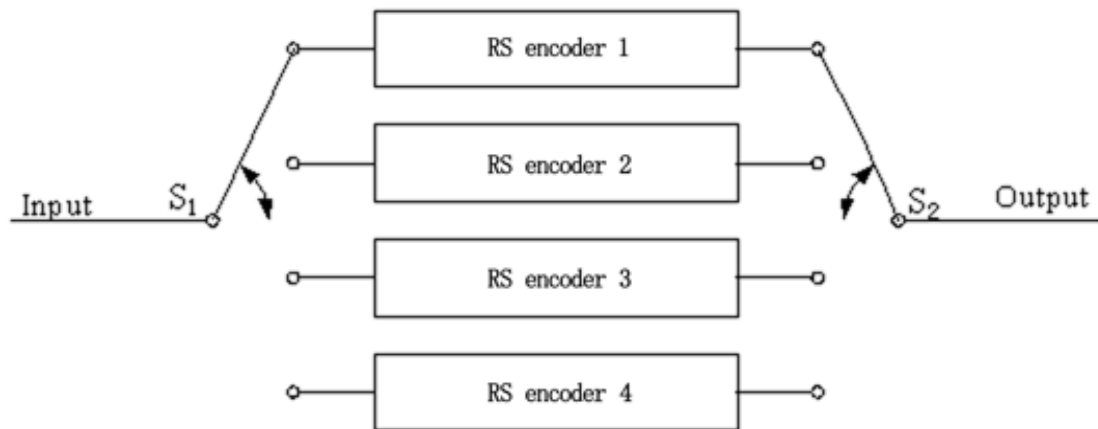$C_2 D_2 \ldots\ldots A_{32} B_{32} C_{32} D_{32}$。

Fig. 3-4 RS coding with an interleaving depth of I=4

On-board RS codes are generated using the Berlekamp approach.

3.2 Conversion

3.2.1 Serial-to-Parallel conversion

In HRPT links, what an information processor sends to an HRPT transmitter is one-channel data. The HRPT transmitter will divide serial data flows received into two- channel parallel data flows in odd and even manner. One of the channels will be given 1-bit delay, so as to match the first code cells into a pair.

Assuming input is $m_1m_2m_3m_4m_5m_6m_7m_8$......
Then the output will be：I：m_1,m_3,m_5,m_7
Q: m_2,m_4,m_6,m_8

3.2.2 Data 8/2 conversion

In DPT links, the solid-state recorder sends eight-channel data to the DPT transmitter. The latter consolidates the parallel data from eight channels into two channels (No. 0, 2, 4, and 6 into one, and No. 1, 3, 5, and 7 into another). One of the channels will be given 1-bit delay, so as to match the first code cells into a pair.

If the input is：flow 0 $A_1A_2A_3A_4A_5A_6A_7A_8$......

Flow 1 $B_1B_2B_3B_4B_5B_6B_7B_{8\ldots}$
Flow 2 $C_1C_2C_3C_4C_5C_6C_7C_{8\ldots}$
Flow 3 $D_1D_2D_3D_4D_5D_6D_7D_{8\ldots}$
Flow 4 $E_1E_2E_3E_4E_5E_6E_7E_{8\ldots}$
Flow 5 $F_1F_2F_3F_4F_5F_6F_7F_{8\ldots}$
Flow 6 $G_1G_2G_3G_4G_5G_6G_7G_{8\ldots}$
Flow 7 $H_1H_2H_3H_4H_5H_6H_7H_{8\ldots}$

Then the output will be：   Flow 1 $A_1C_1E_1G_1A_2C_2E_2G_2A_3C_3E_3G_3A_4C_4E_4G_{4\ldots}$

Flow 2 $B_1D_1F_1H_1B_2D_2F_2H_2B_3D_3F_3H_3B_4D_4F_4H_{4\ldots}$

3.3 Differential coding

When the previous pair of output code cells is same, then $X_{out(i-1)} + Y_{out(i-1)} = 0$, here:

$X_{out\ i} = X_{in\ i} + X_{out(i-1)}$

$Y_{out\ i} = Y_{in\ i} + Y_{out(i-1)}$

When the previous pair of output code cells is not same, then $X_{out(i-1)} + Y_{out(i-1)} = 1$, here:

$X_{out\ i} = Y_{in\ i} + X_{out(i-1)}$

$Y_{out\ i} = X_{in\ i} + Y_{out(i-1)}$

Where：

$X_{out\ i}$, $Y_{out\ I}$ means the current output of the encoder

$X_{in\ i}$, $Y_{in\ i}$ is the current input of the encoder

$X_{out(i-1)}$, $Y_{out(i-1)}$ is the previous output of the encoder

3.4 Convolutional coding and punctured codes

3.4.1 CONV（7,1/2）

MPT downlinks are applied with convolutional coding (7,1/2), with code generating vectors of $G_1=1111001$, and $G_2=1011011$ (G_2 is the inverse output). The coding flow is shown in the following diagram:
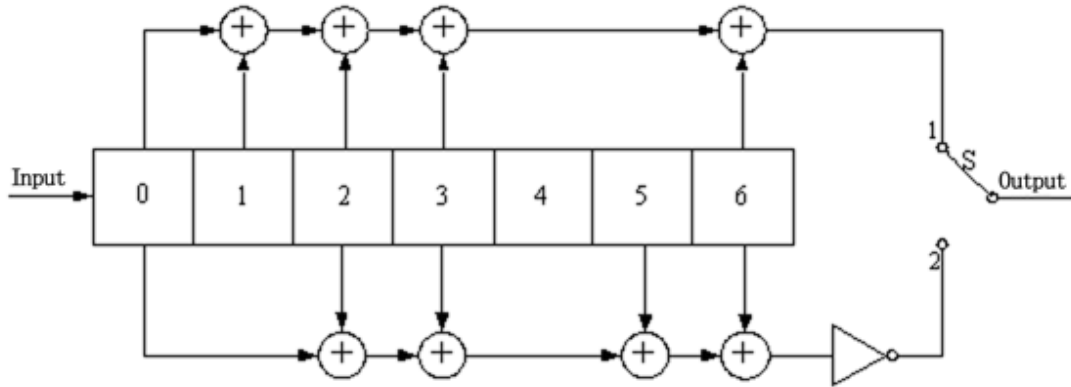
Fig. 3-5 Convolutional coding (7,1/2）

Flow 1：$X_1X_2X_3X_4X_5X_6X_7X_8$……
Flow 2：$Y_1Y_2Y_3Y_4Y_5Y_6Y_7Y_8$……
Output：$X_1Y_1X_2Y_2X_3Y_3X_4Y_4X_5Y_5X_6Y_6X_7Y_7X_8Y_8$……

3.4.2 CONV（7,3/4）

In an attempt to raise the code rate, avoid excessive width demands, and accommodate heavy assignments for convolutional encoding and decoding, both HRPT and DPT links are applied with punctured codes (7,3/4） of (7,1/2). 3/4 code rate is derived from the output of 1/2 convolutional encoder. The coding flow is given in Fig. 3.6.
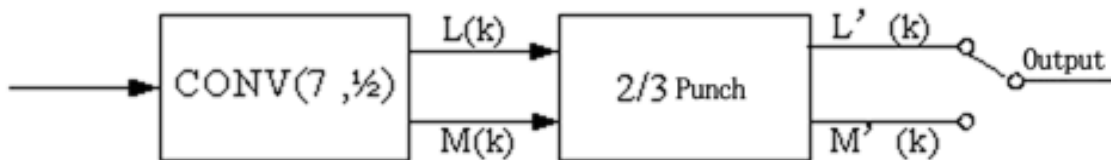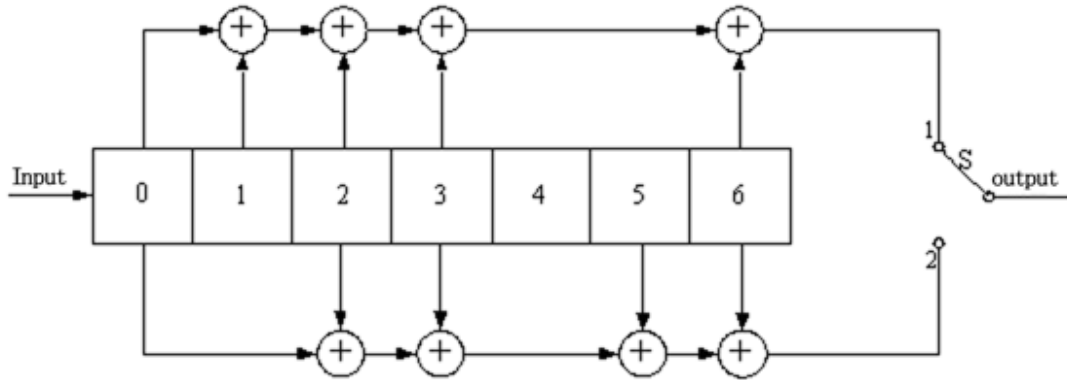

Fig. 3-6 Convolutional coding (7,3/4）

Code generating vector (7,1/2)：$G_1=1111001$, and $G_2=1011011$, with a flow shown as follows:

Input, output

Fig. 3-7 （7,1/2）coding flow for punctured coding（7,3/4）

The following are the details of 2/3 punching process:

2/3 punch module input:：

L(k)=…l(k)，l(k+1)，l(k+2)，l(k+3)，l(k+4)，l(k+5)，l(k+6)，……

M(k)=…m(k)，m(k+1)，m(k+2)，m(k+3)，m(k+4)，m(k+5)，m(k+6)，……

2/3 punch module output:

L'(k)=…l(k)，l(k+2)，l(k+3)，l(k+5)，l(k+6)，……

M'(k)=…m(k)，m(k+1)，m(k+3)，m(k+4)，m(k+6)，……
CONV(7,3/4) serial output:：
…l(k),m(k),m(k+1),l(k+2),l(k+3),m(k+3),m(k+4),l(k+5),l(k+6),……

4. Modulation

Modulation models shall be selected in line with the bandwidth limit allowed for a satellite, and other requirements, including interference resistance, and feasibility. FY-3 is designed with a QPSK modulation system, as the result of a balanced consideration.

The onboard QPSK is a π/2 system. Channel I and Channel Q are the convolutional coding outputs as shown in Fig. 3-1, Fig. 3-2 and Fig. 3-3.
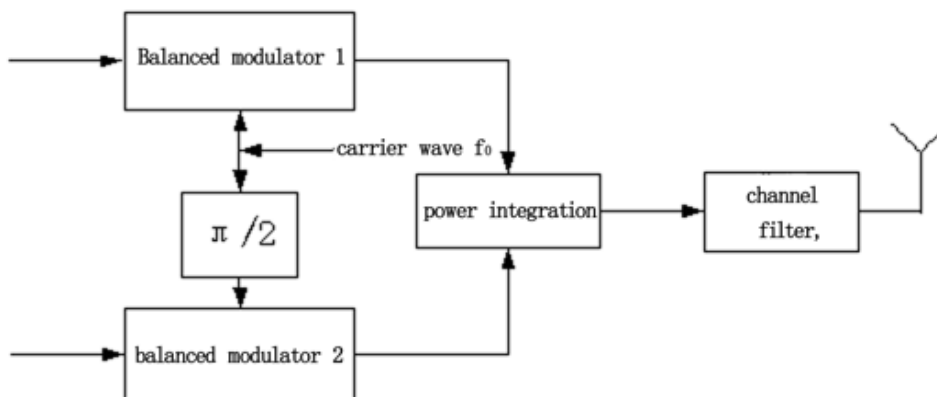
16

Fig. 4-1 QPSK flow

Using gray-code logics, the modulator works in line with the following specifications:

TABLE 4-1 4-PHASE GRAY-CODE MODULATION

Dual-bit coding pair AB	Carrier phase φ
00	0°
01	90°
11	180°
10	270°

5. Satellite-ground data processing
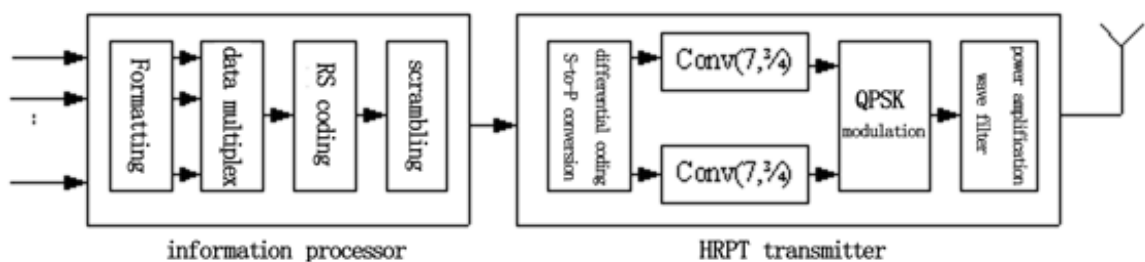
5.1 HRPT links

Fig. 5-1 HRPT links

HRPT flow diagram is given in Fig. 5-1. A range of functionalities, including

data receiving, formatting, multiplex, scrambling, and RS coding, are realized in the information processor, while others, such as serial-to-parallel conversion, differential coding, convolutional coding, modulation, power amplification, and wave filter, are worked out by the HRPT transmitter. All payload data transmitted via HRPT links have to be processed by the HRPT module in the information processor, before going through modulation for transmitting.

5.1.1 Date type

TABLE 5-1 DATE TYPES FOR HRPT DOWNLINKS

Sounder	Receiving mode	Data rate	Length （bytes）
VIRR (day)	Direct	1.3308Mbps	--
MWRI	Direct	100Kbps	--
IRAS	Via 1553B	4 packets/6.4s	1024
SBUV	Via 1553B	1 packet/64s	512
		10 packets /120s （once a day）	
		10*4 packets /month	
TOS	Via 1553B	1 packet/8.16s	832
ERM	Via 1553B	1 packets/4s	1024
SIM	Via 1553B	2~6 packets /30s	512
MWTS	Via 1553B	1 packet /16s	256
MWHS	Via 1553B	2 packets /2.667s	1024
SEM	Via 1553B	1 packet /42s	512
Satellite telemetry parameters	Via 1553B	2 packets /s	256

5.1.2 Data multiplex

Multiplexed data units, transmitted from VIRR, MWRI, and 1553B, have their respective virtual channels at the HRPT module of the information processor. Meanwhile, the payload data from the same sources are buffer stored in a 4K×8bit FIFO. When the memory reaches 882 bytes, a logic dispatch unit concerning status and virtual channels will be sent out. The

unit will take care of VCDU compiling and conversion, in line with sequencing algorithms of releasing speed, priorities, and synchronization. In an attempt to secure the required consistency and fixed code rate for the code flows destined to the real-time physical channels, a virtual data fill-in process will be staged to produce needed data, in case the payload data has not reached the required volume of 882 bytes. The said process is shown in Fig. 5-2.
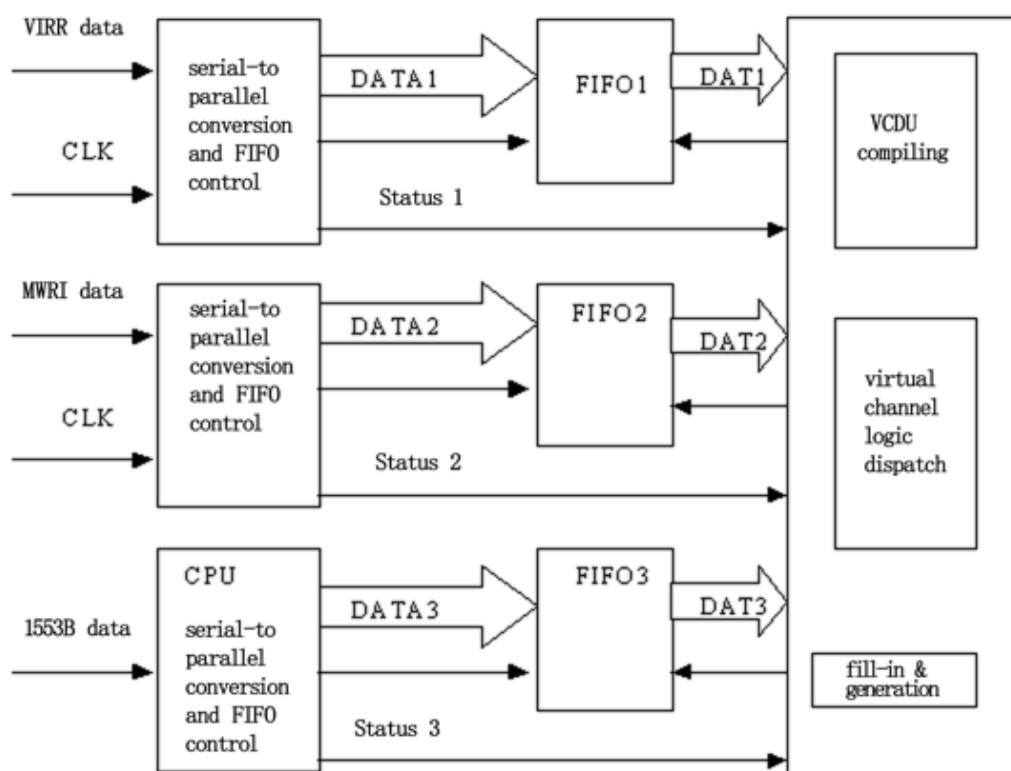

Fig.5-2   MPT data multiplex

5.1.3 Data formatting

When above-mentioned three data flows reach the volume of 882 bytes in FIFO, they shall be framed in line with CADU formats defined by CCSDS AOS.

5.1.4 RS coding

A volume of 892Byte is allowed for the data frames fed into RS coding modules, though header (1ACFFC1D) is not included. The data will be divided into four groups. The four groups, having been turned into interleaved codes, will have 128Byte correction bits at the rear of the data field.

5.1.5 Data scrambling

The data frames will then be processed by the scrambling module, allowing all the data except the synchronous header to go with a 255bit scrambling sequence that is repeated in cycle.

5.1.6 Serial-to-parallel conversion and differential coding

After the above-mentioned processing, L-band real-time information processing module will produce a code rate of 4.2Mbps(FY-3C:3.9Mbps), in non-return to zero code, for HRPT transmitter. The data, after serial-to-parallel conversion and differential coding, will be divided into two channels of data.

5.1.7 Convolutional coding

The two channels of data will be convolutionally coded（7,3/4）.

5.1.8 Modulation model

A QPSK model will be used to modulate two channels of convolutional codes.
Carrier frequency: 1704.50MHz±34KHz(fy-3c :1701.3)
Width (zero): 5.6MHz(FY-3C:5.2)

5.1.9 Power amplification and wave filter

A narrow wave filter will be added before power amplification. A solid-state linear power amplifier will be used for the purpose.
Transmitting power: not less than 11W.

5.1.10 Antenna

Signals have to be amplified and filtered, before sending to HRPT links for transmission. The antenna shall meet the following technical specifications:

Frequency and bandwidth: 1698~1710MHz
Polarization: RHCP(fy-3c :RHCP)
Gain (including RF cable loss): when antenna beam is ±61.71°, not less than 2.5dBi; when antenna beam is 0°, not less than -4.0dBi.
Axial ratio: not larger than 5dB, for an area of ±62°
Direction pattern: multiple beams, and axis of symmetry

TABLE 5-2   HRPT ANTENNA GAIN INDICATORS

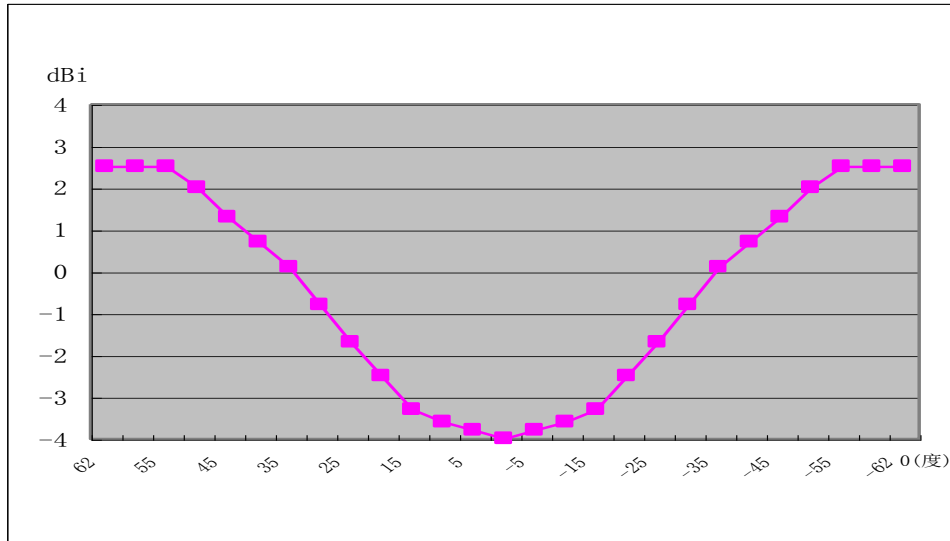| Elevation angle θ(°)	Antenna gain (dBi)
±62°	≥2.5
±60°	≥2.5
±55°	≥2.5
±50°	≥2.0
±45°	≥1.3
±40°	≥0.7
±35°	≥0.1
±30°	≥-0.8
±25°	≥-1.7
±20°	≥-2.5
±15°	≥-3.3
±10°	≥-3.6
±5°	≥-3.8
0°	≥-4.0

Gain curves smooth out between ±62°~0° as follows:

Fig. 5-3 HRPT antenna beam pattern

5.1.11 Key parameters of HRPT link

TABLE 5-3 HRPT RF LINK

Elevation angle	º	5	40	63	90
Carrier frequency	MHz	1704.5 (1701.3)	1704.5 (1701.3)	1704.5 (1701.3)	1704.5 (1701.3)
Orbit altitude	Km	836.4	836.4	836.4	836.4
Ground station G/T	dB/K	5.3	7.3	7.7	8.0
EIRP	dBw	11.0	3.5	1.2	0.3
Code rate	dB-bps	66.2 65.9	66.2 65.9	66.2 65.9	66.2 65.9
System link margin	dB	4.2	5.2	6.5	6.8

5.1.12 HRPT link control

HRPT link control steps are given in Table 5-4

TABLE 5-4 PROGRAMED HRPT LINK CONTROL

Step	Action	Note
	Action	

22

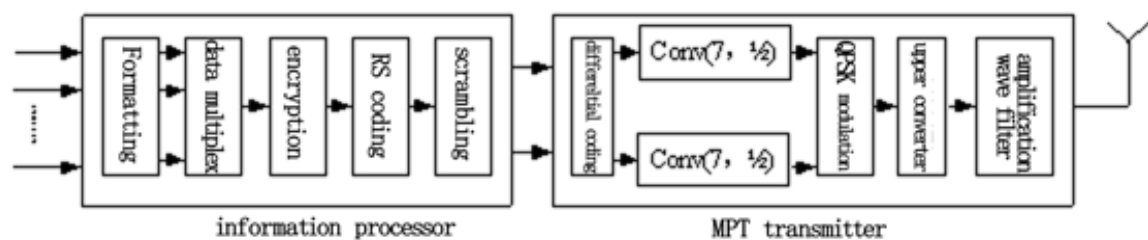| 1	HRPT information processing reset	10 seconds prior to the start of HRPT transmitter
2	HRPT transmitter switches on	
3	HRPT transmitter switches off	

5.2 MPT links

Fig. 5-4 MPT links

The working process of MPT links is shown in Fig. 5-4. Needed functionalities, including payload data receiving, formatting, multiplex, encryption, scrambling, and RS coding, are programmed by the information processor. Other functionalities, such as serial-to-parallel conversion, differential coding, convolutional coding, modulation, power amplification, and wave filter, will be worked out by the MPT transmitter. The payload data (MERSI data only) transmitted via MPT links will be processed by the MPT module in the information processor, before being modulated for antenna transmission.

5.2.1 Date type

MPT links transmit MERIS data, at a rate of 16Mbps.

5.2.2 Data multiplex

Unlike HRPT links, MPT links only take care of MERIS data. The data will be buffer stored in FIFO. VCDU compiling starts, when the memory reaches 882 bytes. A data fill-in process can be staged to ensure the consistency of physical channels (see Fig. 4-2 for details). The data multiplex flow is given in Fig. 5-5.
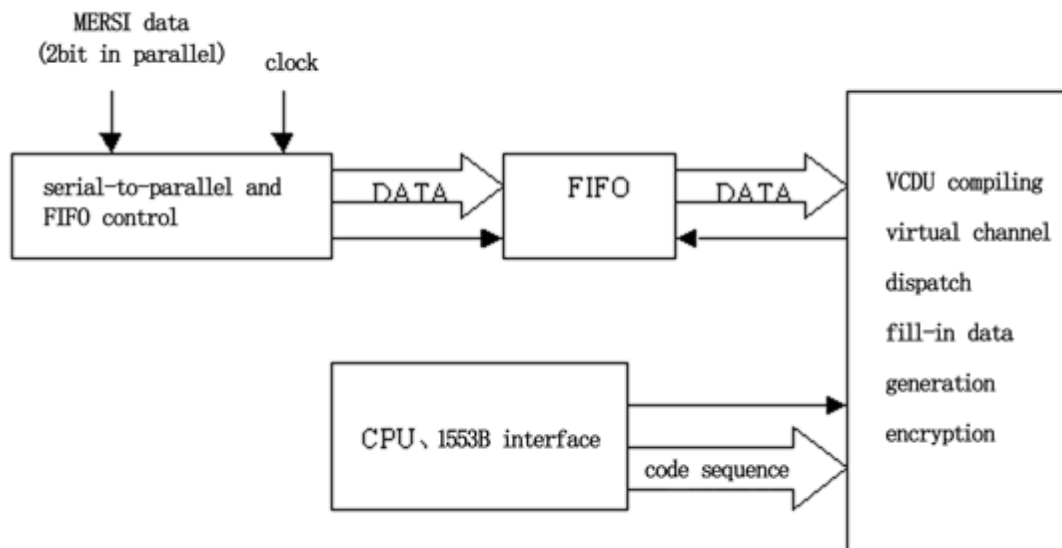
Fig. 5-5 MPT Links

5.2.3 Data formatting

When the data flow reaches the level of 882 bytes in FIFO, it shall be framed in line with CADU formats defined by CCSDS AOS.

5.2.4 Encryption

As it is shown in Fig. 5-5, the key number will be transmitted via 1553B, before being read by CPU. A preset program will generate a pseudo-random sequence, in line with the key generating cycle. The sequence, after repeated changes, can be taken as a source for generating key number sequence. With the help of an open sequencing module, it is possible to generate encrypted data.

The contents of the VCDU insert shall be defined in line with open or encrypted commands. When sending an encrypted command, an identifier and key number shall be saved in the insert. When it is an open command, the key number is 0000H

5.2.5 RS coding

A volume of 892Byte is allowed for the data frames fed into RS coding modules, though header (1ACFFC1D) is not included. The data will be divided into four groups. The four groups, having been turned into interleaved codes, will have 128Byte correction bits at the rear of data field.

5.2.6 Data scrambling

The data frames will then be processed by the scrambling module, allowing all the data except the synchronous header to go with a 255bit scrambling sequence that is repeated in cycle.

5.2.7 Differential coding

After the above-mentioned processing, X-band real-time information processing module will produce a code rate of 18.7Mbps, with a width of 2bit, in non-return to zero code, for MPT transmission. The two channels of data shall be subject to differential coding.

5.2.8 Convolutional coding

The two channels of data will be convolutionally coded (7,1/2).

5.2.9 Modulation model

A QPSK model will be used to modulate two channels of convolutional codes.
Carrier frequency: 7775.00MHz±156KHz(FY-3C:7780)
Width (zero): 37.4MHz

5.2.10 Power amplification and wave filter

A narrow wave filter will be added before power amplification. A traveling wave amplifier will be used for the purpose.
Transmitting power: not less than 23W.

5.2.11 Antenna

Signals have to be amplified and filtered, before sending to MPT links for transmission. The antenna shall meet the following technical

specifications:

Frequency and bandwidth: 7750～7850MHz
Polarization: RHCP(FY-3C:LHCP)
Gain (including RF cable loss): when antenna beam is ±62.0°, the gain shall not be less than 5.0dBi; when it is ±60.0°, not less than 5.5dBi; and when it becomes 0°, not less than -4.5dBi.
Axial ratio: not larger than 8dB for an area of ±62°
Direction pattern: multiple beams, and axis of symmetry

TABLE 5-5 MPT ANTENNA GAIN INDICATORS

Elevation angle θ(°)	Antenna gain (dBi)
±62°	≥5.0
±60°	≥5.5
±55°	≥4.5
±50°	≥2.8
±45°	≥1.0
±40°	≥-0.4
±35°	≥-1.5
±30°	≥-2.3
±25°	≥-3.0
±20°	≥-3.3
±15°	≥-3.7
±10°	≥-4.0
±5°	≥-4.3
0°	≥-4.5

Gain curves smooth out between ±62°~0° as follows:

Fig.5-6 MPT antenna beam pattern

5.2.12 Key parameters of MPT link

TABLE 5-6 MPT RF LINK

Elevation angle	º	5	40	63	90
Carrier frequency	MHz	7775.0 (7780)	7775.0 (7780)	7775.0 (7780)	7775.0 (7780)
Orbit altitude	Km	836.4	836.4	836.4	836.4
Ground station G/T	dB/K	20.4	22.4	22.7	23.1
EIRP	dBw	16.0	7.5	4.7	4.3
Code rate	dB-bps	72.7	72.7	72.7	72.7
System link margin	dB	3.9	6.8	6.9	7.8

5.2.13 MPT link control

MPT link control steps are given in Table 5-7

TABLE 5-7 PROGRAMED MPT LINK CONTROL

Step	Action	Note
Action		
1	MPT information processing reset	10 seconds prior to the start of MPT transmitter
2	MPT transmitter switches on	3.5min after power amplification is on. Wait till the voltage gets up, before turning on the preamp.
3	MPT transmitter switches off	Turn on the preamp, 2s after the transmitter's voltage gets up.
Turn-off		
1	MPT transmitter preamp switches off	
2	MPT transmitter amplifier switches off	Switch off MPT transmitter amplifier, 2s after MPT transmitter preamp is switched off

6.1 Orbital parameters

1) Orbit type: polar orbiting, sun-synchronous
2) Nominal orbit altitude: 836.4km
3) Inclination: 98.753°

6.2 Data transmission

L-Band HRPT downlink
Data rate：4.2Mbps （after RS coded）(fy-3c:3.9M)
Frequency：L-band（1704.5MHZ）(fy-3c: 1701.3)
Modulation model：QPSK
EIRP：41dBm（EL=5°）
Real-time global transmission, with programmed control function

X-band MPT downlink
Data rate：18.7Mbps （after RS coded）
Frequency：X-band（7775MHZ）(fy-3c:7780M)
Modulation model：QPSK
EIRP：46dBm（EL=5°）
Real-time transmission for the areas enjoying international cooperation, and for the domestic areas having a receiving capability. Programmed transmission, and transmission in encrypt mode.