

FY-3 Meteorological Satellite Data Transmission

Abstract

This Paper gives an overview of FY-3 meteorological satellite data transmission. FY-3 meteorological satellite data transmission includes: real time direct downlink of HRPT(High Resolution Picture Transmission), real time direct downlink of MPT(Moderate Resolution Picture Transmission), and delay time downlink DPT(Delay Picture Transmission). The paper also gives an introduction of physical layer, data link layer and application layer about HRPT/MPT/DPT. The physical layer includes: Convolutional Encoding, Synchronization, Marker Insertion, Serial to Parallel conversion. The data link layer includes: VCDU primary header, VCDU insert zone, VCDU data unit zone, Reed Solomon check symbol field, Randomization; The application layer includes: Application data Source packet structure. The worst link budget in a typical case on specification is also given. And so on.

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3 .Data link layer

The structure of one CVCDU accord with AOS OF CCSDS. The Reed Solomon Check Symbol Field contains the check symbols which allow error correction. They are generated with interleaving depth of I=4
Coding :RS(255,223)

1 .Overview

FY-3 meteorological satellite provides three types of science data return capabilities. When FY-3 satellite passes overhead, the three downlinks transmit synchronously.

The three downlinks include:

- 1) Real time direct downlink of HRPT;
- 2) Real time direct downlink of MPT;
- 3) Direct playback for delay time data link of DPT

HRPT transmission with L-band
MPT and DPT transmission with X-band
DPT transmits over China area
MPT transmission have translucent mode and encrypt mode.
When MPT transmission in encrypt mode, user ground receiving station should obtain a license from NSMC before receiving MPT.

2 .Application data layer

1) Application data provided with HRPT

The application data provided by the HRPT link are as follows:

- VIRR(Visible-And Infrared Radiometer) data
- IRAS(Infrared Atmospheric Sounder) data
- MWTS (Microwave Temperature Sounder) data
- MWHS(Microwave Humidity Sounder) data
- SBUS(Solar Backscatter Ultraviolet Sounder) data
- TOU(Total Ozone Unit) data
- MWRI(Microwave Radiation Imager) data
- SIM (Solar Irradiation Monitor) data
- ERM(Earth Radiation Measurement) data
- SEM(Space Environment Monitor) data

2) Application data provided with MPT

The application data provided by the MPT link include: science instrument data of MERSI (Medium Resolution Spectral Imager)

3) Application data provided with DPT

The application data provided by the DPT link are as follows: MERSI data, VIRR data, IRAS data, MWTS data, MWHS data, SBUS data, TOV data, MWI data, SIM data, ERM data and SEM data

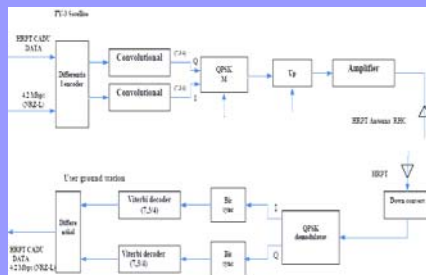
4 .HRPT downlink

Data rate: 4.2Mbps (after RS coded)
Frequency: L-band (1704.5MHZ)
Modulation model: QPSK
Band: 5.6MHz
EIRP: 41dBm (EL=5°)
Clock stability: 2×10-5

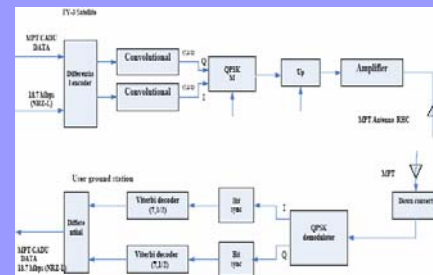
5 .MPT downlink

Data rate: 18.7Mbps (after RS coded)
Frequency: X-band (7775MHZ)
Modulation model: QPSK
Band: 37.4MHz
EIRP: 46dBm (EL=5°)
Clock stability: 2×10-5

HRPT Satellite to ground station downlink configuration



MPT Satellite to user downlink configuration



6 .Encoding of HRPT downlink and DPT downlink

1) Randomization

$$F(X)=X^8+X^7+X^5+X^3+1$$

2) Convolutional encoding

Code rate: CONV (7, 3/4)

Constraint length:7bits

Connection vectors: G1=1111001; G2=1011011

Phase relationship: G1 is associated with the first symbol

Symbol inversion: NO

4) Source packet structure

Packet primary header (48bits)						Secondary header 6octets	User data variable	
Packet identifier 2 octets		Packet sequence control 2octets		Packet length 2octets			time stamp 48 bits	ancillary data
Vers on NO 3 bits	type 1 bit	Secondary header flag 1 bit	API D 11 bits	sequence flag 2 bits	Sequence count 14 bits	16 bits	var	data
*000	*	*						

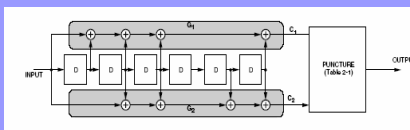
5) Application data overview

Data rate and VCID and APID

application	Data rate	VCID(BIN)	APID
MERSI	15.8Mbps	000011 VC1	
VIRR (day)	1.3308 Mbps	000101 VC2	
VIRR (night)	0.39924 Mbps	001001 VC3	
MWRI	30Kbps	001010 VC4	
IRAS	2560bps	001100 VC5	000,0000,0011
ERM	1024bps	001100 VC5	000,0000,0101
MWTS	80bps	001100 VC5	000,0000,0111
TOU	815bps	001100 VC5	000,0000,1001
SBUS	128bps	001100 VC5	000,0000,1011
SIM	800bps	001100 VC5	000,0000,1101
MWHS	6150bps	001100 VC5	000,0001,0000
SEM	100bps	001100 VC5	000,0000,1111
Telemetry data	4096bps	001100 VC5	

Table 1-1: Puncture Code Patterns for Convolutional Code Rates

Puncturing Pattern	Code Rate	Output Sequence
1 = transmitted symbol 0 = non-transmitted symbol		$C_1(t), C_2(t)$ denote values at bit time t
C ₁ : 1 0	2/3	C ₁ (1) C ₂ (1) C ₂ (2) ...
C ₂ : 1 1		
C ₁ : 1 0 1	3/4	C ₁ (1) C ₂ (1) C ₂ (2) C ₁ (3) ...
C ₂ : 1 1 0		
C ₁ : 1 0 1 0 1	5/6	C ₁ (1) C ₂ (1) C ₂ (2) C ₁ (3) C ₂ (4) C ₁ (5) ...
C ₂ : 1 1 0 1 0		
C ₁ : 1 0 0 0 1 1	7/8	C ₁ (1) C ₂ (1) C ₂ (2) C ₂ (3) C ₂ (4) C ₁ (5) C ₂ (6) C ₁ (7) ...
C ₂ : 1 1 1 0 1 0		



7. Encoding of MPT downlink

1) Randomization

$$F(X)=X^8+X^7+X^5+X^3+1$$

2) Convolutional encoding

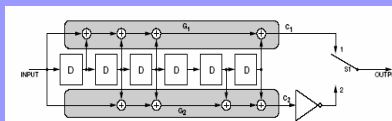
Code rate: CONV (7, 1/2)

Constraint length:7bits

Connection vectors: G1=1111001; G2=1011011

Phase relationship: G1 is associated with the first symbol

Symbol inversion: NO



The output symbol sequence is: C₁(1), C₂(1), C₁(2), C₂(2), ...