

OUTLINE OF SATELLITE JAS-1

JS1UKR, Fujio Yamashita
Japan Amateur Radio League

Introduction

The first Japanese satellite, JAS-1, is scheduled to be launched in 1986 by Japanese H-1 rocket. A special feature of JAS-1 is its digital transponder with memory, in addition to a normal analog transponder. It will be possible to upload digital messages into the transponder memory, and the messages will be relayed to someone with the appropriate access code (e.g. callsign). In this way, JAS-1 will be able to carry messages (on a store and forward rather than real-time basis) between amateurs anywhere in the world.

Two birds of JAS-1 were completed in the fall of 1985 and all necessary testing was carried out and certified that the characteristics of satellite were no problem. The cost for constructing this satellite is about 400 million yen (US\$ 1.6 million).

Major Specification of JAS-1

Launch and Orbit

Launch at : early in August, 1986
Launch by : NASDA, with H-1 rocket
Launch from : Tanegashima Space
Centre, Japan
Orbit : circular, altitude of
1500 km
Period : 120 minutes
Inclination : 50 degree
Life : 3 years

Construction

Weight : 50 kg
Configuration : polyhedron of 26
faces covered in
solar cells
Size : 400mm(dia.) x 470mm
(height)

Communication Subsystem

Analog (JA) and digital (JD) communication in mode J.

Transponders

Analog Transponder (linear transponder)

Input frequency: 145.9 - 146 MHz
(bandwidth 100kHz)
Output frequency: 435.9 - 435.8MHz
(inverted sideband)

Reqd. uplink eirp: 100 W
Transponder eirp : 2 W PEP

Digital Transponder

Input frequency: 4 channels,
145.85, 145.87,
145.89, 145.91 MHz
Output frequency: 435.91 MHz (1 ch)
Reqd. uplink eirp: 100 W
Transponder eirp : 1 W rms
Signal format : 1200 baud PSK,
store and forward

Beacon and Telemetry

JA beacon: 435.795 MHz, 100 mW,
CW or PSK
JD telemetry: 435.910 MHz, 1 W,
PSK

Figures 1 and 2 show the structure and the system block diagram of JAS-1.

Consisting units of communication subsystem are named as follows:

JRX : receiver of both analog and
digital signals
JTA : transmitter for analog signal
JTD : transmitter for digital
signal
DDEM : demodulator for digital
signal
DCM-A: digital communication
module A
DCM-B: dit. B

Digital Transponder

Digital transponder consists of JRX, DDEM, DCM-A and B, and JTD. Figure 3 shows the block diagram of communication subsystem. Uplink signals of four chan-

nels are accepted at the same time, while downlink signals are delivered only through one channel, for efficient use of traffic. Frequency spectrum for JAS-1 is shown in Figure 4. Digital QSO is possible not only for station to station, but for BBS or sending telemetry data of satellite in packet, by means of the protocol AX. 25, level 2, version 2.

The uplink signal carries Manchester-coded NRZI/HDLG data, and this signal is demodulated by DDEM, that contains four communication channels and one command channel. Output signals of DDEM are processed by four-channel HDLC of DCM-B to deliver them to CPU of DCM-A. DCM-A is composed of CPU, NSC-800, memory of 1 Mbyte made of 256 kbit DRAM, A-D converter, encoder and so on. CPU processes signals of communication and telemetry signals, and analyses command signals. Communication signals, as well as telemetry data, are transformed into packet by HDLC of DCM-B, and JTD transmits these signals by PSK modulation, at the frequency of 435.91 MHz, 1 watt of power.

Antenna

Antenna system consists of three parts: the receiving antenna, the transmitting antennas for both analog and digital signal, all having almost omni-directional characteristics. The receiving antenna is a monopole set at the top of the satellite. Each of two transmitting antennas has four elements around the satellite. These are connected to the antenna power divider (APD) and phase shifting cables, to make the radiation pattern circular. Radiation is LHCP looking the satellite at its bottom.

QSO via Digital Transponder

Equipments for digital QSO via JAS-1 are not so different from that on the ground link, except modem for PSK signal. As the communication control device, TNC of AX. 25, level 2 is available. Current

communication equipment may not have PSK modem, so it is requested to prepare PSK modem. Transmitter for uplink should be 145 MHz of FM and downlink receiver, 435 MHz of SSB.

Bit rate of data is 1200 bps and the modulated signal for uplink is F2 and for downlink, SSB. Data to be transmitted is transformed into Manchester code, by clock signal, produce F2-modulated RF signal of 3 kHz bandwidth. Downlink signal is transmitted by SSB with PSK modulation, and this is converted into audio frequency, and is synchronously detected. After detection, data are fed to TNC, through a low-pass filter and adjusting amplifier. An example of the modem for communication via JAS-1 is shown in Figure 5. It is important and interesting problem to overcome Doppler effect in various passes of the satellite.

Closing Remarks

Project of JAS-1 was planned and has been promoted by JARL, under which the amateur satellite committee has taken the role of steering the plan. Manufacturing of the satellite is carried out by NEC Corporation of Japan and the satellite repeater group of the committee. The satellite repeater group, of which members are excellent staffs from the JAMSAT (Japan AMSAT), made both analog and digital transponders and the digital memory by their own hands. NEC is responsible not only for manufacturing of power system and satellite structure but also for system design and integration. This work is supported by many people in the world, and here we are to thank them heartily. And we are expecting nice flight of JAS-1 and nice QSOs all over the world via JAS-1.

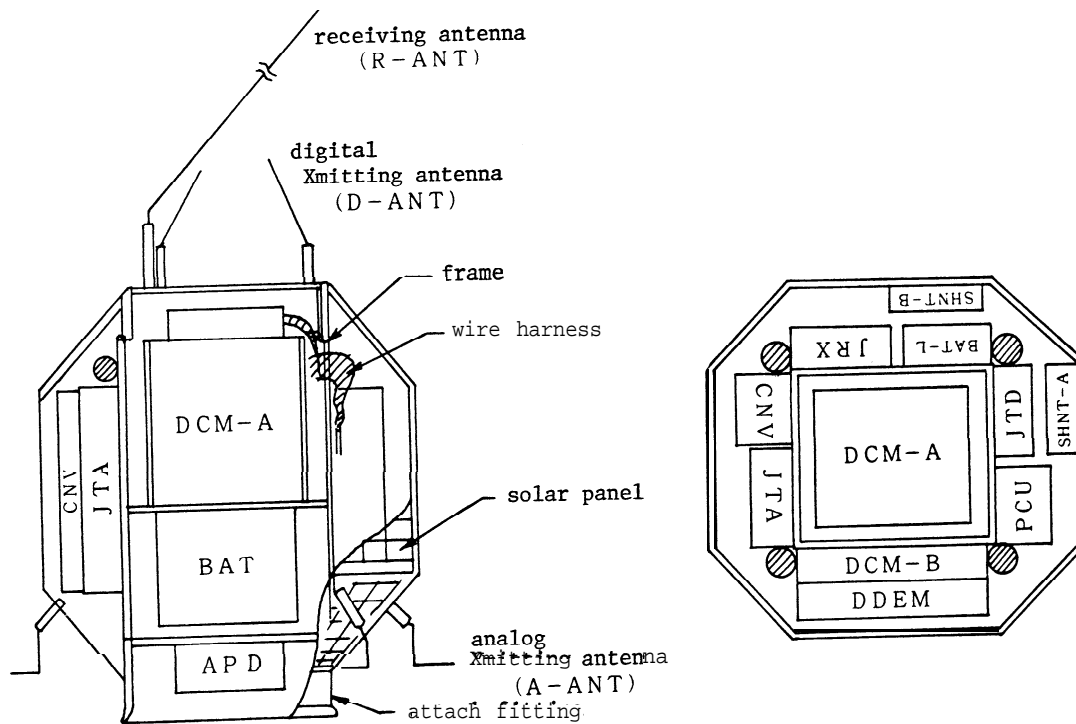


Figure 1. Structure of JAS-1

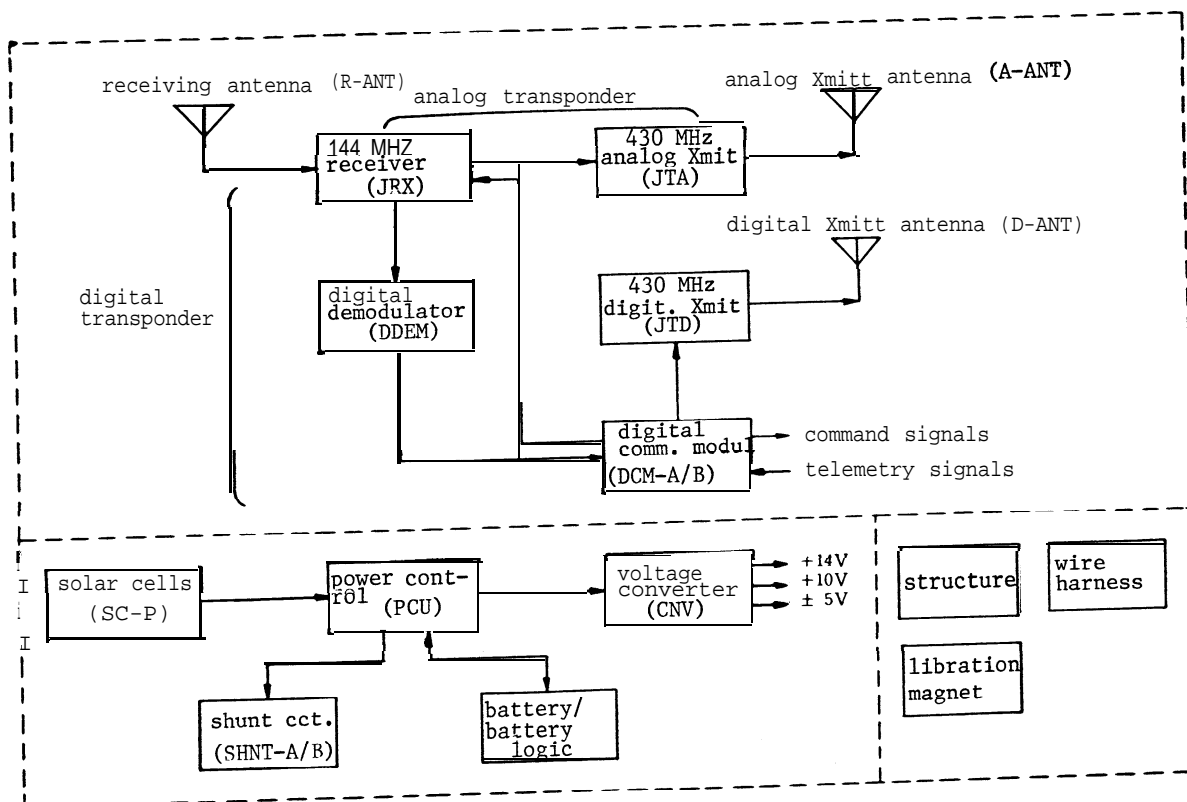


Figure 2. Block diagram of JAS-1 system

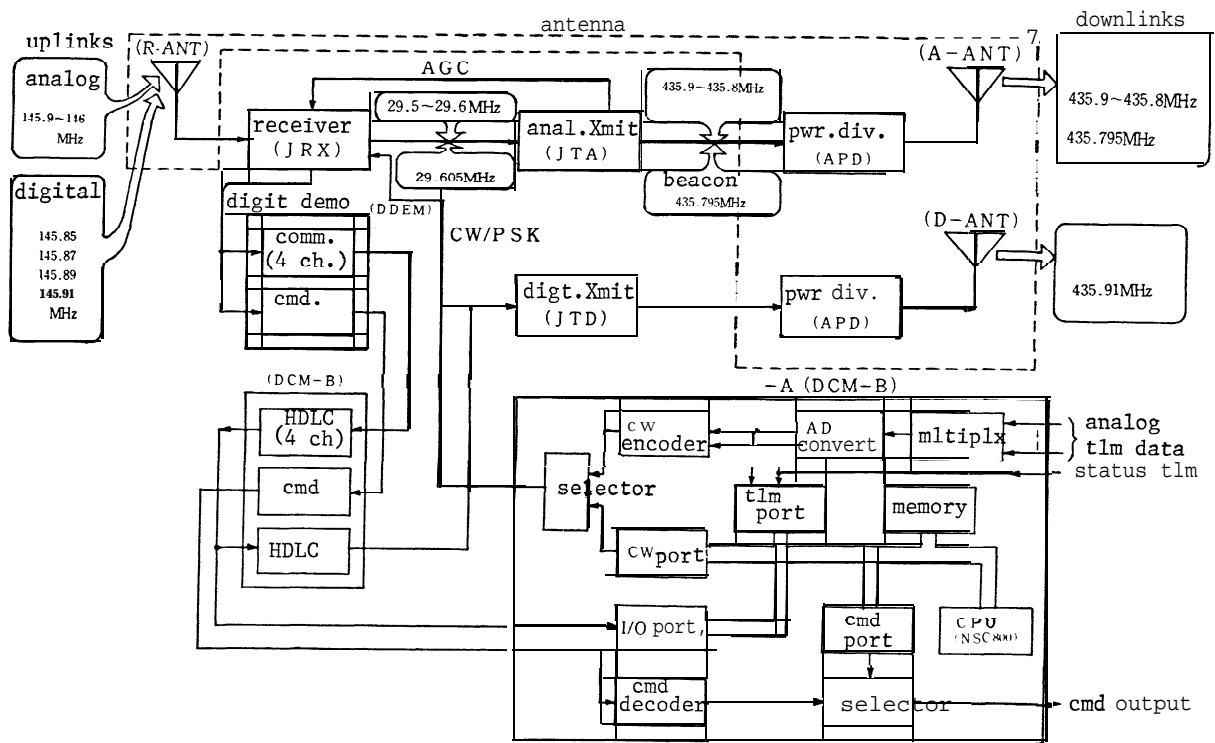


Figure 3. Block diagram of communication subsystem

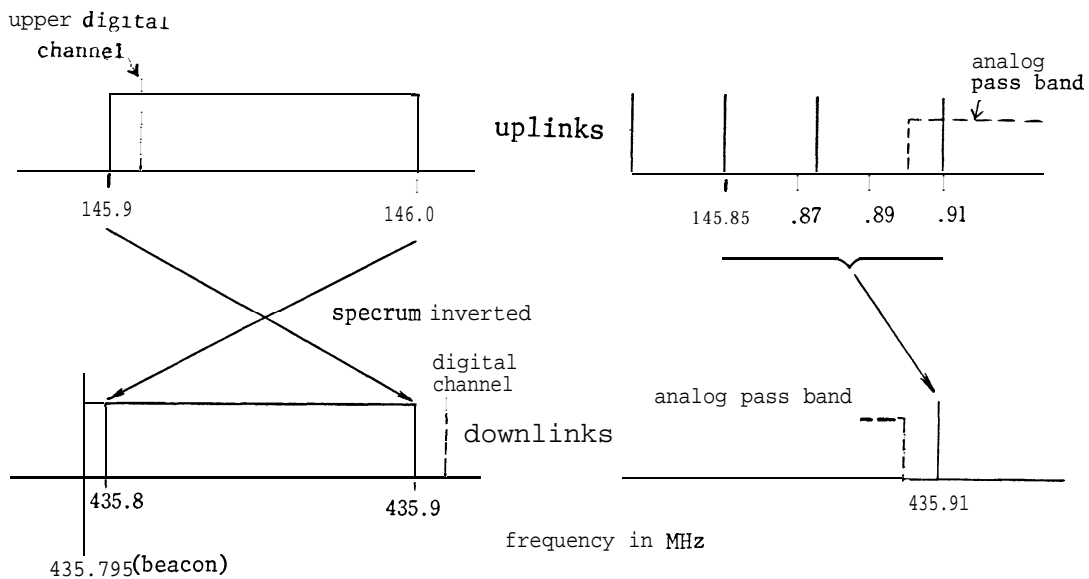


Figure 4. Frequency spectrum of JAS-1

