

Chinese New Telemetry Onboard System

Shi Chang Jie

China Aerospace Corporation

Abstract

This paper at first gives a brief historical review of chinese development of telemetering onboard system and then make a brief introduction of new onboard system from several respects.

Key Words

Concentrating type, Distributing type, Signal conditioning

Introduction

Since 1958 China began to establish space telemetry technology. Transfer from copy to self design was very fast. Around 1960, with some improvement points we copied Soviet telemetry PTC-6, PTC-3 systems. PTC-3, PTC-6 are PAM-FM, PAM-FM-FM systems. After the copy work we started to design PACM-FM system and PCM-PSK-PM system. The PACM-FM system combined PAM, PCM in one system. The PAM part was used for fast varying parameters and the PCM part was used for slow varying parameters. The data rate was higher than before. The PCM-PSK-PM was the first tracking system of continuous wave. In this system there were two channels. One channel was realitime low data rate channel and the other was storage delay transmission channel.

Before 1960 we only used meter wave band. In 1970s we developed system which combined PCM-FM, PACM-FM, PCM-PSK-PM together. Except meter wave band we used microwave C band.

Since 1985 chinese telemetry technology has got into fast development period. The specification is drawing close to international level in big stride.

Onboard System

After international investigation, for reducing the distance of technology comparing to foreign country, we develop new onboard system according to the international

technical level. From the systematic respect the fundamental rule of design is:

We notice that in 1980s the foreign country's onboard systems have large flexibility and large coverage of utility. But in China every model of measured objects has used different type onboard system. It is very difficult for developing engineers. When develop new system we must increase the flexibility and coverage of utility. We must develop standardized system. We must develop modularized subsystem or subsystem's parts in series. Standardized system means the dimension and connector of every parts is designed according to standard. Modularized subsystem means the video subsystem used bus to connect modules. The configuration may be large or small and the coverage of utility is increased. Subsystem parts developing in series means the radio subsystem may be developed a series of products according to the different requirement. Miniaturized system means we must use advanced technology and smallest elements to reduce the volume and weight. The configuration technology of electronic parts is using the advanced technology in China and the smallest elements acquire from China or international market.

Make Full Use of Computer Technology

The fundamental way of increasing flexibility and the coverage of utility is making full use of computer technology. The concrete method is using bus to connect modules. The system may be developed very free. The configuration may be large or small.

The chief hardwares of this system are central master unit and remote slave unit. In central master unit we use CPU & EPROM operating together to control the whole system. The first is to control the frame pattern of data acquisition. On satellite this unit also used for preprocessing and data compression. The remote slave unit is used for data acquisition, A/D transformation. signal conditioning.

Frame synchronizing code length, bit rate, gain & offset of signal conditioning, parameter sequence etc. can be controlled by central master unit. Length of every word may be different. From central master unit to remote slave unit, we use series bus for connection. There are two types may be selected. One is star series bus connection, i.e. one bus connects one remote slave unit. The second is one series bus connects many slave units in parallel. Also we can mix these two types each other. The series bus has two sets. The data

information and the control information are transmitted on different set. The pattern of data agree with standard 1553. In central, remote slave unit we use parallel bus to connect modules.

Concentrating Type, Distributing Type Radio Frequency Parts in Series

The largest configuration is distributed type system. There are one central master unit and several remote slave units. This type is suitable for large measured objects, multiple cabinet objects. For small measured object, the concentrating type is more suitable. Concentrating type only has central master unit and in this unit has one module for data acquisition.

We use parallel bus to connect different modules in master and slave units and use series bus to connect different remote slave units. So that the configuration has very large flexibility and large coverage of utility.

We develop a series of transmitters for different users.

For some special utility, we can use the upper modules to form telemetering subsystem and can be combined with orbit measuring subsystem, remote control subsystem together.

Two Types of Signal Conditioning

Former we only considered one type signal conditioning, i.e. transducer & signal conditioning parts are merged together using microminature technology. Now we consider two types. One is the former what we considered. The other is signal conditioning facing to video subsystem. Many signal conditioning parts are merged together in the remote slave unit. The gain and offset or the signal conditioning parts are controlled by master unit.

Unit Structure Style

The unit structure style of foreign country products has several types. Although all these types are modularized but concrete structures are not the same. Our unit structure style is shown in Fig.1. The wide and height of modules are standardized and all the modules are the same Thee thickness may be different according to the function of the module. Some may occupy one unit thickness and some may occupy several unit thickness. At the four corners of each module

have four holes. At two sides of master unit or slave unit have cover plate. Four bolts through the holes of modules and covers are used to fix the position. Between modules we use three direction connector to connect each other. One direction pins connect the upward modules. The opposite pins connect the downward modules. The third direction pins is used to connect PCB or porcelain substrate. The master unit or slave unit connect to outside by connectors at one side of modules. This three directions connector is developed in special.

Miniaturized Technology

We have two types of modules dimension. The type of 60x60(mmxmm) is miniaturized parts. The dimension is the dimension of frame. The dimension of PCB or pocelain substate only is 36x32(mmxmm). The miniaturized technology is:

The digital circuits of video subsystem (VLSI, EPROM, CPU and high velocity A/D converter) are import from foreign country. The other digital circuits are 5000 gates gate array which is produced by China. Also we use import EPLD. The configuration of digital electronic circuit, we uses multilayer PCB and not uses surface mounting technology. The analogue video circuit is thick film circuit and uses surface mounting technology. The radio circuit uses thin film connection technology, thin film nonpower circuits, concentrating parameter individual elements and import MIC circuits.

Some Specification

The block diagram of concentrating, distributing types are shown in Fig, 2 & 3. The specification agrees with international standard IRIG & CCSDS.

Modulation PCM, PCM-DPSK-PM, PCM-QPSK

Frequency Band S band

Programing Ability

Frame pattern, frame code length, word length, sequence and acquisition rate of parameters, the gain and offset of signal conditioning part.

The code length is programable word by word. This system may be programmed before use or realtime programmed as you need.

Multi Data Stream Output

Transmitter's Power developed in series.

Storage We have two types of storage:

A. Short time delay electronic storage.

B. Long time remember and retransmission storage.

Central Master Unit:

CPU & EPROM combine control. CPU control is used for packet telemetry. Packet telemetry is used for multiple users. In this condition it is a very flexible system for dynamic management. Information of telemetry must be packeted. Adding header to define the information source and the path of data flow. In the transmission frame, the different source's information may be interleaved and controlled by CPU for dynamic management. Packet telemetry belongs to the international space standard CCSDS.

Conclusion

Since 1985 our plan of development work is toward the international technology level. Our work is quite perfect.

Reference

Airborne Telemetry Trends for the 1990's

Richard E, Van Doren Aydin Vector Division

ITC Proceedings -1989

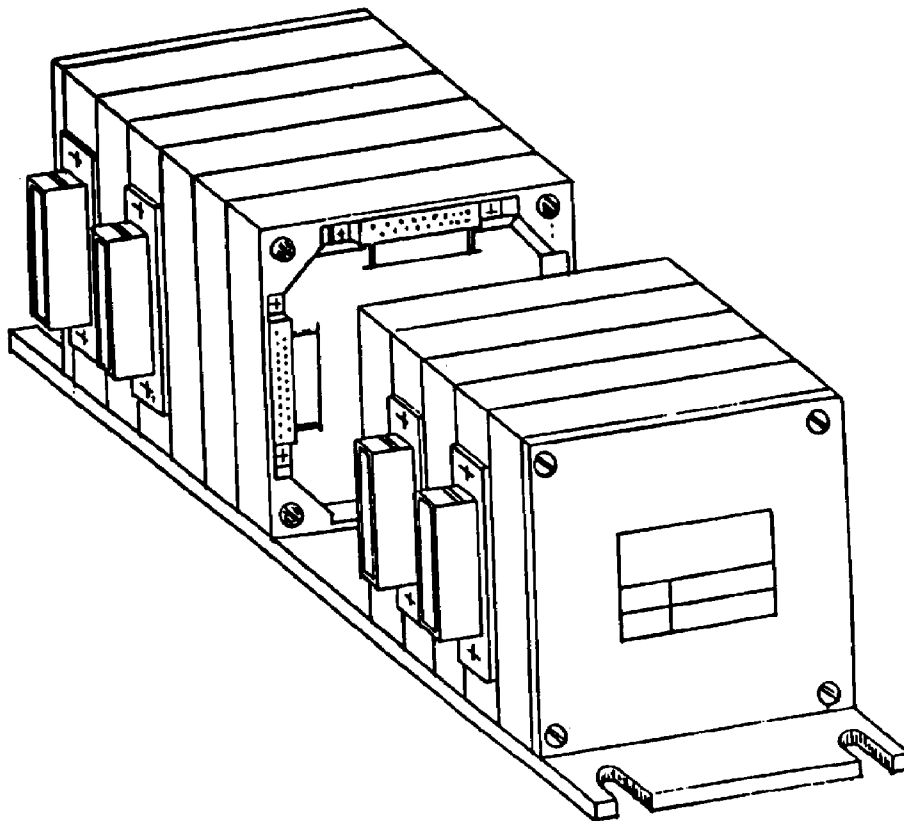


Fig.1 Unit structure style

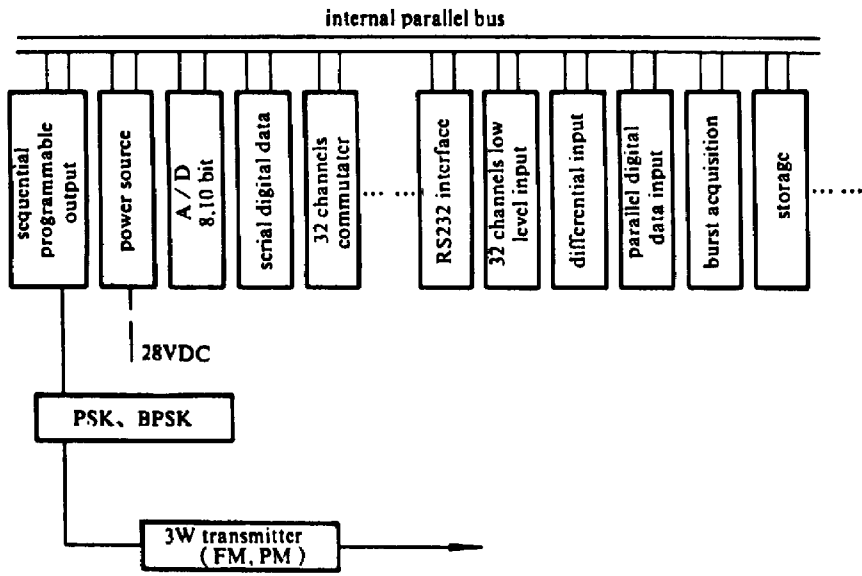


Fig. 2 Block diagram of concentrated type

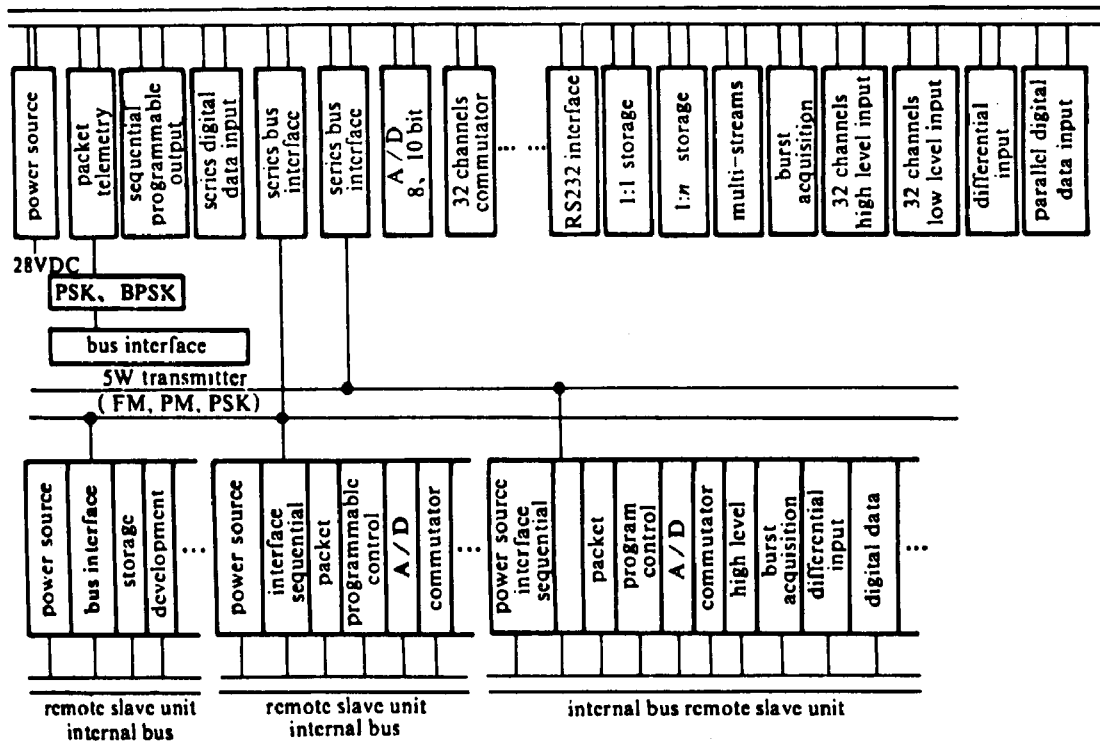


Fig. 3 Block diagram of distributed type