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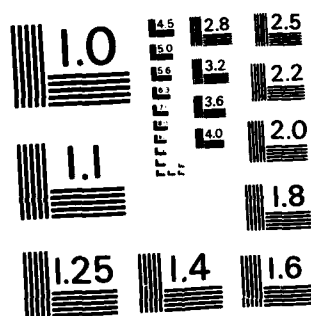
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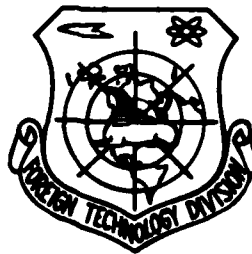
FOREIGN TECHNOLOGY DIVISION



FROM LAUNCHING CARRIER ROCKETS TOWARDS THE PACIFIC
ON THE ACCOMPLISHMENTS AND PROBLEMS OF ELECTRONIC
TECHNOLOGIES IN OUR COUNTRY

by

Gu Zeng-pei



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Electronics Forum

FROM LAUNCHING CARRIER ROCKETS TOWARDS THE PACIFIC ON THE ACCOMPLISHMENTS AND PROBLEMS OF ELECTRONIC TECHNOLOGIES IN OUR COUNTRY

Gu Zeng-pei

In May 1980, our country successfully launched a carrier rocket towards the Pacific Ocean. This activity was not only an important test of the rocket technology in our country, but also an overall evaluation of the electronic technology in our country. Electronic technology is the technology of accessing, processing and treating information. Some people have summarized it in six words: measuring, transmitting, recording, displaying, computing and controlling. In this experiment, all six areas are fully functional.

Measuring: The tracking measurement is the most important in the flight test of carrier rockets. We not only must measure the various fast changing and slow changing parameters inside the rocket during the flight process of the carrier rocket using remote measuring techniques and transmit them to the ground, but also must track and observe the rocket from the ground to accurately determine the flight trajectory from the launch point to the splash point. The accuracy requirement on the measurements is very high. For example, in the major arc section of the trajectory, the accuracy of velocity measurements in the three directions of motion, X, Y, Z must reach several centimeters per second. The accuracy of position determination must be on the order of magnitude of meters. In order to reach these high requirements, the total plan for measurement consists of many systems. It includes systems such as the single pulse radar, continuous wave interferometer, and continuous wave multiple station ranging and velocity measuring systems. The purpose is to fully utilize the advantages of different systems. In order to measure the entire flight trajectory in the experiment, we not only established many surveying stations on land, but also built two long range ocean vessels with relatively complete functions. The long range survey vessel

itself is a small, but a complete electronic world containing "measuring, transmitting, recording, displaying, computing, controlling" as a single unit.

Transmitting: In addition to the usual communications transmission duties, the major factor is the one way or two way transmission of the data obtained by the measuring stations and the vessels through the data exchange center on a real time basis. Due to the fact that the amount of data is large, therefore, it is required that each channel must have the transmission rate of several thousand bits per second. In order to ensure the necessary accuracy, the miscode requirement is also very strict. As for the means, there is wired transmission as well as wireless transmission. They form a land and sea unified long range data transmission network. Also, time synchronized signal transmission should also be mentioned. The measurement data of the flight trajectory of a rocket will become completely meaningless without a unified and highly accurate time indicator. Due to the fabrication of the atomic clock in our country and the establishment of medium wave and shortwave time broadcasting stations, requirements in this aspect were also satisfactorily met.

Recording: Regarding the various data obtained in the experiment, part of them were used in real time processing and real time control; most of them were used in high accuracy data processing after the fact. Out of these data, a small portion of them were recorded on films using an optical method, and most of them were recorded using electronic recording techniques. The parameters in the rocket, besides being transmitted to the ground through real time remote measurements, were also recorded using magnetic recording devices. They were retrieved after ejection before splashing down. The data package picked up from the oceans contains such a set of devices.

Displaying: The various types of information obtained in the flight test of the carrier rocket not only must be transmitted to places where the information is needed, but also very frequently are

required to be converted into numerical codes, letters, symbols or graphs. They are displayed on the screen or the display plate in order to allow the relevant personnel to understand the situation audio-visually. A judgement can then be made in time.

Computing: The process of the rocket flight experiment is short. However, the amount of data to be processed is vast. For example, the real time control of the carrier rocket, the mathematical guidance needed to capture the target at the various observation stations scattered all over, the orientation of the observation ship, the maintenance of the stability of the measuring equipment with respect to the target when the ship is in a swaying state, and the conversion of the original data to the display information will require the fast computations of the electronic computer. This experiment involved the use of over 20 large, medium and small computers which operate on the order of several thousand to several million times per second. They satisfied the requirements of real time processing and post-treatment.

Controlling: Control is an important aspect in space electronic technology. In the experimental process, the computer and the execution mechanism onboard the carrier rocket control the various activities of the rocket accurately. This is to ensure that the object carried enters the predetermined trajectory accurately. The ground remote control equipment controls the safety of the rocket on a real time basis. In case the rocket malfunctions, and deviates from the trajectory, the remote control equipment will immediately issue an order to the rocket to self-destruct according to the calculated result given by the computer. This is to avoid or minimize the losses on the ground as the rocket falls. Of course, the rocket operated normally during the test. It has always passed along the correct trajectory. Therefore, such an order was never used. However, the safety control system has always reliably maintained such capabilities. Since 1975, our country has successfully controlled the accurate re-entry of satellites several times. This fact is the best indication that our remote control technology has already reached the current standard.

In the entire experimental process, the electronic devices onboard our carrier rocket and the tens of pieces of large scale electronic equipment on the ground operated normally according to the predetermined program. The information flow was rational and smooth. The data links were connected accurately. There was no backlogging and no interference. The arrangement was proper. The work was coordinated well. A complete set of test data was obtained. Therefore, we can say that this overall evaluation of electronic technology proved that we have obtained satisfactory results, whether in terms of single item technology or total system engineering. This accomplishment indicated that our electronic engineering technology has already reached a comparatively high standard.

However, compared with technologically advanced countries, there is some difference in the electronic technology at the current stage. There are technically insufficient areas in the various aspects of survey, transmit, record, display, compute and control. This will have to be overcome by our research and development, as well as our production units. In order to continue to develop our electronic technology so that our electronic engineering equipment is competitive internationally, some general questions are raised here for the reference of workers in electronic technology and management in electronic engineering technology.

I. Improvement of reliability is the number one priority. Poor reliability is the largest weakness in our electronic engineering technology. The electronic devices engaged in this test were carefully chosen for quality and maintained with care. However, there were individual devices breaking down partially in the middle of the mission. This reflects the seriousness of the problem. The reason why most of the equipment showed good reliability during the preparation and execution of the mission is because the development and production units strengthened their quality control. Each element was rigorously selected. The designs were based on reliability. A reliability indicator was assigned to each component, and based on it each component

was evaluated. Therefore, the reliability indicator of the equipment as a whole was assured. In addition, in order to adopt to the need of carrier rockets, in recent years a "seven specialties" measure has been adopted in the production of key elements (special personnel, special machines, special material, special batch, special check, special rejection, special card). We have obtained very obvious results. The level of reliability is improved by about one order of magnitude as compared to the original standard.

These practices indicated that, as long as we seriously and realistically work hard and pay a certain price, it is possible to relatively quickly change the present status in reliability. Poor reliability is not only an electronic technological problem, but also a management problem in technical development and production. The only way is to pay more attention to it from the top to the bottom and to place it as the number one priority if we intend to resolve this problem completely.

II. To focus on basic electronic products. The development of electronic engineering technology and the improvement of the characteristics of the electronic equipment are eventually limited by the characteristics of the basic products. Space electronic technology and its matching ground equipment frequently present some relatively high requirements on the frequency range, frequency band, sensitivity, stability, accuracy, power, power loss, weight, volume and environment. Whether these requirements can be met from an engineering design point of view is often determined by the performance and quality of existing basic products, such as transistors, vacuum tubes, integrated circuits, wave guides, line cables, printed boards and connectors. Moreover, the performance indication of these basic products is limited by the raw materials, fabricated materials, reagents, processing techniques and processing technologies. From this, one can see that in order to make good basic electronic products, many factors are involved. It requires the joint effort of scientific technical work and organizational coordination work. The leading institution must have the spirit to control everything from top to

bottom in order to resolve the problem of "leg pulling" at certain links in time. In the meantime, it should be noticed that only those new products which are already technically matured can be applied to engineering. Furthermore, sufficient room in specification should be left in the design in order to ensure that the new products can work reliably and stably in the engineering project.

III. To increase the standard of automated monitoring and testing. As the capability of the electronic device strengthens continuously, it must also become more complex technically. If the tuning and testing means of the equipment still remain at the original level, and still rely on the conventional meters to read, convert, adjust and determine various parameters manually to maintain the equipment, then it is unavoidable that extreme difficulty will be encountered by the users. Furthermore, it will be hard to satisfy the time and efficiency requirements of the mission.

In recent years, the development of microprocessors has been relatively fast in our country. The wide use of microprocessors is an effective way to improve the level of automation in monitoring and testing. Even if the equipment is very complex, if a microprocessor is closely linked to it with centralized audio-visual displays in words and figures, it will be possible to greatly simplify the operation and maintenance of such a piece of equipment. Consequently, the number of operators can be reduced and the error can also be minimized.

IV. To improve the service and to be technically responsible. The reliability problem of our electronic equipment can hardly be completely resolved in a short period of time. The difference between advanced foreign standards also cannot be eliminated rapidly. The way to compensate for it is to greatly improve the technical service based on the actual situation in our country. Speaking about the ground equipment for satellites and carrier rockets, the development units have always been providing technical services to the user units according to the principle that they are "fully

responsible". This also means that they are not only responsible for the installation, adjustment and technical training of the new equipment, as well as the check-ups at regular intervals, but also continue to bear the responsibility. No matter what time and whatever goes wrong, if the user unit cannot resolve the problem, the development unit will quickly dispatch technical personnel to assist. This type of thorough technical responsibility service should be attainable for various large scale electronic items. It is also feasible. This is the largest advantage of our development and production units in our domestic market when we compete with foreign manufacturers. It should be fully utilized to the extent possible.

V. To reduce cost and price. Our domestic electronic products, especially the basic products, are highly priced. In comparison to similar foreign products, some are several times or even several tens times higher in price. This is especially true for products with higher reliability. This is one of the important reasons why some user organizations are willing to purchase foreign products. If the prices are not lowered, due to the law of economics, the results are that the larger users will purchase from foreign countries, while the smaller users will stop using them because they cannot afford it. Thus, it will be difficult for the electronic industry and electronic technology to continue to grow. The research and development departments and production departments of electronic products must try to improve the management methods, advance the technology, increase the productivity and product superiority and reduce waste. They must try to sell in large quantities at low profits. The cost and the price tag should be drastically reduced.

VI. To establish a proof-of-need system to adequately limit imports. In order to accelerate the four modernizations in our country, it is absolutely necessary to bring in advanced technologies from foreign countries. However, due to the lack of a specific understanding by some of our units with regard to the level of electronic technology in our country, on top of the fact that the leadership ideology is not clear as well as some other factors, there has been

the phenomenon in recent years of importing some large scale electronic equipment and systems. If such a phenomenon does not change, the further development of our electronic technology will be severely affected. Part of the electronic technological power which has already reached a relatively high level may have the tendency to stall or shrink.

In view of the carrier rocket tests launched towards the South Pacific, we can obtain an estimate on the level of electronic industry and electronic technology in our country: Most of the electronic engineering and electronic equipment needed for the construction of our country at the present moment can be developed and produced by ourselves. Therefore, we must focus on bringing in advanced technology. The imported equipment can only be devices we still cannot develop and produce. We should actively organize our efforts to create the conditions so that we will be able to make the equipment ourselves. If we are stalled because of some basic electronic products, then we can import a portion of the elements or parts. Only those we really cannot develop and produce at the present moment can be purchased from abroad. Therefore, we would like to suggest to the relevant leading authorities that a proof-of-need system should be set up to establish the value of the items being brought in, when approving the requests for the importation of electronic equipment. The ones which are proved to be technically valuable will then be approved for importation.

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