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PROGRESS REPORT

PERIOD OF 1 MAY 1965 TO 31 MAY 1965

CONTRACT NUMBER AF 33(600)40280

BY

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SPECIAL HANDLING

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A F-101 FLIGHT TEST

Flight Tests

Five flights were flown during May, as indicated in the program summary in Table I. Radar tests were devoted to evaluating the low noise pre-amplifier performance and obtaining data for linear receiver evaluation. The linear receiver data was acquired by varying receiver gain on repeated fly-bys against a corner reflector pattern located at Bolling Field.

An after-burner problem in the aircraft restricted mapping flights to low altitude and reduced flight time on three of the flights to allow engine tests at high altitude. None of the attempted fixes have been effective in correcting the after-burner misfire, which occurs only above 30,000 feet.

A summary of the individual flights appears in Appendix A. Flight 165 was aborted due to a failure in the transmitter; flight 167 was unsuccessful because of a recorder failure.

TABLE I

F-101 PROGRAM SUMMARY

May 1965

Flights Scheduled		11
Flights Accomplished		5
Aircraft	1	
Radar	4	
Flights Cancelled		6
Weather	1	
Aircraft	3	
Transmitter	2	
In-flight Failures		2
Transmitter	1	
Recorder	1	

Modifications and Ground Tests

Transmitter

The transmitter TWT developed a grid-to-cathode short during flight 165. Since the replacement tube was longer than the older defective tube, waveguide fittings and mounting bracketry had to be modified. The replacement tube would not saturate, even with 3 watts of RF drive, causing poor pulse shape and transmitter servo coincidence. Transmitter 002 was then replaced by 001. Initial power measurements were 26 watts average power. Changing the CFA high voltage increased power output to 69 watts with a pulse width of 31 nanoseconds.

Receiver

During preflight for 166, a noise figure of 18.3 was measured. Replacing a defective module in the Tunnel Diode Pre-Amplifier restored the system noise figure to 6.5 db.

After flight 166, the Tunnel Diode Amplifier was replaced by the Westinghouse Parametric Amplifier to complete the flight tests of this modification which were begun in January 1965. Intermittent gain variation and oscillations were noted during Flight 167. The Par-Amp was retuned, this time while operating into the receiving TWT in its normal configuration. Apparently the high input VSWR of the TWT caused instabilities until compensated for by retuning. Performance during flight 168 was excellent. System noise figure is 5.2 db; amplifier gain is 17 db. Bandwidth at the 1 db level is 157 mc, at the 3 db level, 233 mc.

Following flight 164, the limiting IF amplifier in the video channel was converted to a linear amplifier in order to demonstrate in-flight the effect of receiver non-linearity. Measurements

verified the received linearity. Sufficient flight data has not been gathered for complete evaluation of non-linearity effects.

Other Failures

During preflight for 168, the +60 volt power supply lost regulation. The breadboard power supply was installed on the missile door.

The pressure window between the transmitter and antenna burned open during flight 164. The pressure system checked out and VSWR measurements of the system waveguide and antenna did not indicate any existing conditions which could cause this failure. The problem has not been encountered again; however, transmitter power output is now less than at the time of failure.

Forward Look System

No flights were made with the forward look system because of instabilities in their circuitry.

B SYSTEM

Recorder

The improved flip-flop circuitry has been wired into the electronics package from recorder 007. Tests have been encouraging. Following one more flight, this electronic package will be substituted in recorder 005 for flight testing.

Low Noise Receiver Pre-Amplifier

Reflector supplies, pump tube, waveguide components, control circuitry, and frame wiring are available and complete for the deliverable Par-Amp installation. Since circulator delivery has been delayed until mid-June, the system installation is not expected to be complete until late July.

Motion Compensation

After receiving the parts to reduce the peak transient response of the integrator, one unit was modified. Results of the transient response tests were as predicted. Frequency response measurements remain to be performed.

Antenna

Several investigations were started following the failure last month of the spare module at 275°C.

(1) A second module was temperature-pressure tested to determine if a different batch of Doryl adhesive would be satisfactory. This module failed at 200°C and 10 psig pressure in the same way as the first module.

(2) A special batch of Doryl without a wetting agent additive was obtained and applied to several sticks. Three test sticks held psig at 288°C, but all failed when the pressure was increased to 20 psig. Bonding with Doryl will be further tested, with a chemical cleaning process added to the procedure.

(3) Dupont states that no changes have been made to their ML fabric, the original material used on the antenna. Since it is expected to delaminate as before, no further tests are planned.with the ML.

(4) Westinghouse Research Labs proposed two new techniques. One involved bonding of a fiberglass film to a metal foil, etching the foil to correspond to the slot areas of an array stick, and welding the foil to the array stick. The second procedure bonds the I8 fabric to the array sticks through heat and pressure without an adhesive. Since the second technique appears more feasible, experimental work has been authorized. Preliminary experiments will be

performed on 12 waveguides; if successful, 16 array sticks for one module will be bonded.

(5) Vacuum will be investigated as a different means of preventing breakdown. Four test sticks were bonded conventionally with the Doryl. Leakage rates will be checked on these sticks and coating applied to the fabric to reduce the leakage so that vacuums of approximately 10^{-3} mm. of mercury can be attained. Electrical tests will follow.

C ENVIRONMENTAL TEST

Recorder 006 passed a full explosion test. Since torque motors were known to arc in use, they were specially tested to prove that they would not cause an explosion. Details are reported in report STM-169.

D SPARES

No items were added to either system or Ground Support Equipment spares this month. Status of spares is as follows:

	Items Shipped	Items Open	Per Cent Complete
System	2	15	99
Basic list plus first 10 amendments	2	10	99
Amendment 11 (remains open)	0	5	--
Ground Support Equipment	0	4	99

E GROUND SUPPORT EQUIPMENT

After preliminary tests indicated the Film Evaluator scanner box was compatible with the new optical bench components, several items were fabricated and the optical axis of the scanner changed to make the bench a practical test tool to measure azimuth resolution. Several plots of single and multiple targets show -20 db sidelobes, with a dynamic range greater than 30 db at low light levels. The

test set-up is still being evaluated.

F CORRELATOR OPERATION

In addition to processing the F-101 flight film, one minor modification was made to the Correlator. The wedge interference filter holders were shortened to allow more motion to compensate for changes in the focal length across the field. Twice the range is now available, permitting compensations of $\pm$ 5 per cent in focal length or approximately $\pm$ 2 per cent in aircraft velocity/film speed ratio.

Royal X Pan Recording Film 5475 used as the final film is no longer available. The replacement film type 2475 has similar speed but less dynamic range. When chemically processed as the 5475, it also has a higher gamma. By processing at 80° temperature rather than 90°, a lower gamma and better dynamic range were obtained. All output films will now be processed in this manner.

Much effort was spent on the Detail Correlator this month. A series of photographs were made using the designed 4.4 to 1 aspect ratio, the 1.4 to 1 ratio obtained by inverting the cylinder conjugates, and the 1.2 to 1 obtained by adding a small meniscus cylinder near the primary output plane. Both 4X and 18X magnifications were made. While the 1.2 and 1.4 aspect ratio were more pleasing, the output field with these two set-ups was curved approximately 3 inches across 1 3/4 inches. The field was flat for the 4.4 to 1 arrangement.

Photographs of various targets on seven flights were taken on Polaroid Type 55 Positive/Negative film. This film allows fast results for analysis and repetitive work, and gives a relatively high resolution negative for further enlargement. Because of the high gamma of the Type 55, it is not suitable for comparison of low return areas.

G CORRELATOR DESIGN REVIEW

The design review report is delayed because of incomplete information from Itek on their correlator noise and film studies and insufficient experimental time on the correlator at Westinghouse.

APPENDIX A - SUMMARY OF FLIGHTS

Flight No.	164	165	166
Date	5-3-65	5-11-65	5-19-65
Altitude	22,500	22,500	22,500
Area	Washington, D.C.	Washington, D. C.	Washington, D. C.
Purposes	Aircraft after-burner test, data acquisition.	Aircraft afterburner and receiver linearity tests.	Receiver linearity test
Significant System Changes		IF limiting eliminated	Transmitter 001 installed -26 watts
Results	APN-102 Doppler Navigator intermittent. Best part tetween half and full range. Contrast is good; resolution is slightly below average. Divergent clutter of bridges etc. is strong. Also strong targets blank out background in azimuth. Some smearing over full range, may be due to motion. Second and third runs are below average in both contrast and resolution. Density variations may be due to motion.	No data due to transmitter failure	Receiver gain switch left in 0 db position on all runs. Low level targets such as grass or trees stronger than usual because of high receiver gain. Details like airport lights show up better than usual. Resolution of road map is good -15' were light dimensions. Corner reflectors 8' apart were separable. Cloud effects were checked; no discernible attenuation or scattering. Contrast at low levels very good. Strong target divergent clutter and azimuth background blanking by strong targets was present.

Flight No.	167	168	
Date	5-26-65	5-28-65	
Altitude	22,500	22,500	
Area	Washington, D.C.	Washington, D.C.	
Purposes	Aircraft after-burner and receiver linearity tests	Receiver linearity test	
Significant System Changes	63 watts average power Par-Amp in place of TDA in receiver (5.db less receiver gain)	6.4 db less RF gain than flt. 166.	
Results	No data due to recorder failure.	6 runs were made at -5, -10, and -15 db IF gain. On most runs, low level contrast was very good. Water and shadowed areas were cleaner than usual unless near a strong target which had some divergent clutter (slight on Run #5, -15 db gain setting). Resolution was good over best areas. Strong target halo did affect immediate surroundings.	