TERMINATION REPORT
ON THE
HG6000 PLATFORM (ERECTION) COMPUTER
FOR THE
ASTRA VERTICAL AND HEADING REFERENCE
SYSTEM
OF THE
CF-105 AVRO ARROW AIRCRAFT

CR-ED 1067 June 24/59

TERMINATION REPORT

ON THE

RG6000 PLATFORM (ERECTION) COMPUTER

FOR THE

ASTRA VERTICAL AND HEADING REFERENCE SYSTEM

OF THE

CF-105 AVRO ARROW AIRCRAFT.

Honeywell Controls
Military Products Document CR-ED 1067.

June 24, 1959.

Prepared by:
D.J. Wright,
Design Engineer
Military Products

Approved by:
A.A. Hills,
Chief Design Engineer,
Military Products.

Honeywell Controls Limited,
Military Products and Systems Engineering Division,
Toronto, Ontario.

TABLE OF CONTENTS

ILLUSTRATIONS

FOREWORD

This represents one of four documents related to the Astra Vertical and Heading Reference System as prepared by Honeywell Controls Limited in accordance with the requirements of Section 2(a) of Contract DSS/DGAS 819009/0013/719-16-30-601, D.D.P. Serial Number 2-PP-8-13.

It is recommended that this report be read in conjunction with the following Honeywell Control Documents:-

CR-ED 1061 Termination Report on the DG6000 Three Axis Repeater for the Astra Vertical and Heading Reference System of the CF-105 Avro Arrow Aircraft

CR-ED 1065 Termination Report on the CG63 Miniature Stable Platform for the Astra Vertical and Heading Reference System of the CF-105 Avro Arrow Aircraft.

CR-ED 1066 Termination Report on the DG-6002 Stabilisation Repeater for the Astra Vertical and Heading Reference System of the CF 105 Avro Arrow Aircraft.

TERMINATION REPORT ON THE MG6000 PLATFORM (ERECTION) COMPUTER FOR THE ASYNA VERTICAL AND HEADING REFERENCE SYSTEM OF THE CF-105 AVRO ARROW AIRCRAFT.

1. GENERAL

The platform computer was a part of the D-YGY09A-1 Level and Heading Reference System for the Avro Arrow Aircraft. It contained the D-MG6000A-1 and A2 Servo Repeaters described elsewhere. In addition to the components associated with these repeaters were a Computer Power Supply, a Filter Limiter Unit and a Balance Network Unit.

The function of the Platform Computer was to provide output signals to maintain the desired position of the D-0063A-1 3-Axis Platform, used on the Level and Heading Reference System. Position and velocity signals from the Aircraft Navigation Computer were processed to maintain the platform level and pointing north independent of aircraft motion. In addition, circuitry was included for initial alignment of the platform after power was first turned on.

2 BACKGROUND

The platform computer was set up to mechanize the torquing signals from the platform gyro. These signals force the platform to follow the curved surface of the earth rather than remain fixed in inertial space. As the equations of motion and navigational maps to be used were changed, the scope and design of the computer changed. Aircraft north and east velocity V_N and V_E, base latitude L_{TB}, and change in latitude during flight it were derived from the navigation computer. Initially, platform deviation from level, plus linear accelerations A_N and A_E, were derived from accelerometers on the platform. For initial heading alignment several schemes were proposed in the early stages, including; (a) a master flux valve in the hangar, and (b) a tape method to calculate aircraft position relative to the hangar automatically. These signals were combined in a separate transistorized amplifier for each platform axis and fed out to the platform gyros. The stabilization repeaters were initially a separate unit. Later the torquing equations were simplified, the summing amplifiers and initial alignment circuitry were moved to the D-EG151A-1 Platform Amplifier, and the stabilization repeaters were combined with what remained. The final stage of evolution was the complete elimination of the platform computer. The stabilization repeaters were replaced by a resolver and potentiometer on the platform gimbals. The precision power supply was incorporated in the platform amplifier. The accelerometer preamplifiers, filter limiter and balance network were eliminated when the platform accelerometers were replaced by mercury switches.

3 RELEVANT SPECIFICATIONS

Design was predicated upon the following specifications and the various Military Specifications as referenced therein.

MIL-E-7894A
Astra 1 Standards
Astra 1 Administrative Memo #18
R.C.A.F.Specification Air 7-6
R.C.A.F. Specification Inst. 92-5
T.D.S. 12269-04, Minneapolis-Honeywell Technical D sign Specification for the HG6000 Platform Computer.

4 DESCRIPTION OF UNIT

4.1 General

The D-MG6001A-1 Platform Computer consisted of the following components: a precision DC power supply, a dual filter limiter, a dual balance network, 2 accelerometer preamplifiers, 1 - D-DG6002A-1 Servo Repeater and amplifiers and power supplies associated with this Servo Repeater

Overall dimensions were approximately 9 1/4" deep x 7" wide x 5 7/8" high. Weight was approximately 18 pounds. Electrical power and signal leads were taken to Bendix Pygmy PC06E type plugs for connection to the Platform Amplifier.

4.2 Mechanical Design

The Platform Computer (Fig. 1) was located in the duct bay of the aircraft and hence was subject to an expected ambient of 260°F. Efficient use of available cooling air from the air conditioning system was therefore added to economy of size and weight and ready availability for maintenance as essential layout criteria. Components were so arranged that cooling air, admitted through a readily detachable connection (Fig. 2), would be directed against them in decreasing order of heat sensitivity prior to being exhausted into the duct bay through a port in the bottom of the case. The exterior of the case was "bright-finished" to minimize heat absorption from the environment.

A model representing a true thermal simulation of the equipment was constructed (Fig. 3) to confirm the adequacy of cooling as well as to study vibration and general structural compliance to specifications.

4.3 Precision Power Supply

This power supply was required to provide accurate DC voltages to potentiometers in the navigation computer. These in turn supplied precision DC torquing signals to the gyro summing amplifiers. Requirements were for dual voltages of +8 and -8 volts with floating centre tap for very close initial accuracy and the relatively high order of stability of 0.3% under a combination of environmental conditions. The load was almost

a fixed quantity at 9.0K ± 2.5%. No power supply was available in a reasonable size to meet this requirement so the unit shown (Fig. 4) was designed. The basic regulating components were the pair of silicon zener regulators VR1 and VR2. These consisted of 1 silicon zener diode each, with 2 forward conduction silicon diodes selected for temperature compensation over the temperature ranges -55°C to +70°C.

4.4 Accelerometer Preamplifiers

The function of these units was to take the relatively low power levelling signals from the platform accelerometers and amplify them sufficiently to permit satisfactory limiting operation. The units chosen for the purpose were Airpax type M5175 Ferrac Magnetic Amplifiers. This type of amplifier provided polarity reversible DC output for DC input. The maximum output is 6.3 volts. Initial offset is 0.12 volts max. referred to the output. Input supply power is 2.5 watts of 115 volts at 400 cycles. Input, output and feedback circuitry was located in the filter limiter and balance network.

4.5 Balance Network

Since the initial and temperature induced offset (output with zero input) was too large in the Airpax magamps for this application, trimming provision had to be included in the balance network unit for 2 amplifiers. Work had not been completed on this unit at the time the contract was terminated.

4.6 Filter-Limiter

The layout and circuitry are shown in Figure 5. This circuitry in association with the two accelerometer preamplifiers performed two functions. The platform accelerometers being subject to aircraft vibration put out signals having the desirable steady state shift masked by a large AC component. Capacitors C1, C2, C3, (C5, C6, C7) totalling 10 mfd. connected across the input winding of the magamp provided filtering of frequency components above 1.8 cps attenuating at the rate of 40 db per decade. CH1 (and its counterpart CH2) provided filtering of the amplifier output. The amplifier output is limited to 6.3 volts by zener diodes D1 and D2 connected back to back. The platform accelerometer signals were limited in

this way to approximately 0.1g in order to limit the rate at which the platform could be torqued off level during an aircraft manoeuvre involving acceleration. Limiting value accuracy was ± 10%.

5 PERFORMANCE

Testing of the power supply proved it to be within specifications on all counts of initial accuracy, stability with load change, line voltage and temperature change and maximum ripple. For two power supplies the following results were obtained.

Initial accuracy 0.1% and 0.05%
Change with line voltage 0.2%
Change with load 0.17% and 0.12%
Change with temperature 0.13% and 0.11%
Output ripple - 14 millivolts.

The tests on the accelerometer preamplifiers associated with the filter limiter and balance networks verified that the combination was within the desired specifications except at extremes of temperature.

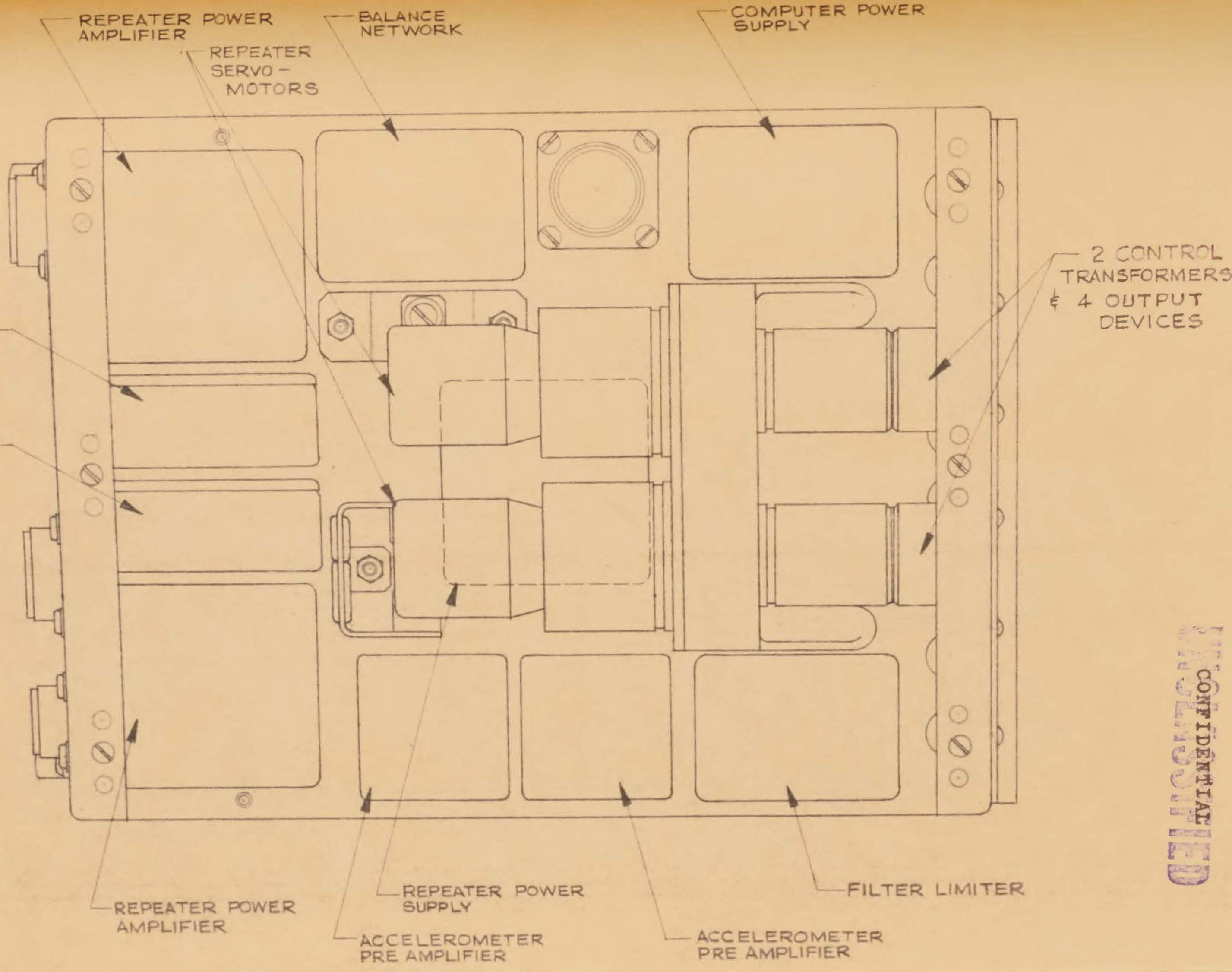
6 STATUS AT CUT-OFF

Cessation of activity on the Platform Computer resulted from design changes as described in Section 2 of this document and in Section 4.1.1 of Honeywell Controls Document CR-ED 1065. Termination of this phase was not attributable to the Astra Cancellation.

At the time of termination of this item, drafting layout had been completed, as had detail drawing on all component units. Four power supplies had been constructed and had passed all developmental model qualification testing. Four filter limiters were under construction and the thermal test model described in section 4.2 had been completed. Temperature tests on the latter were interrupted before significant data was obtained.

7 FUTURE PLANS

Testing of the breadboard was to be completed. Drafting and construction of the platform computer were to be completed.



HC/MP Document CR-ED 1067

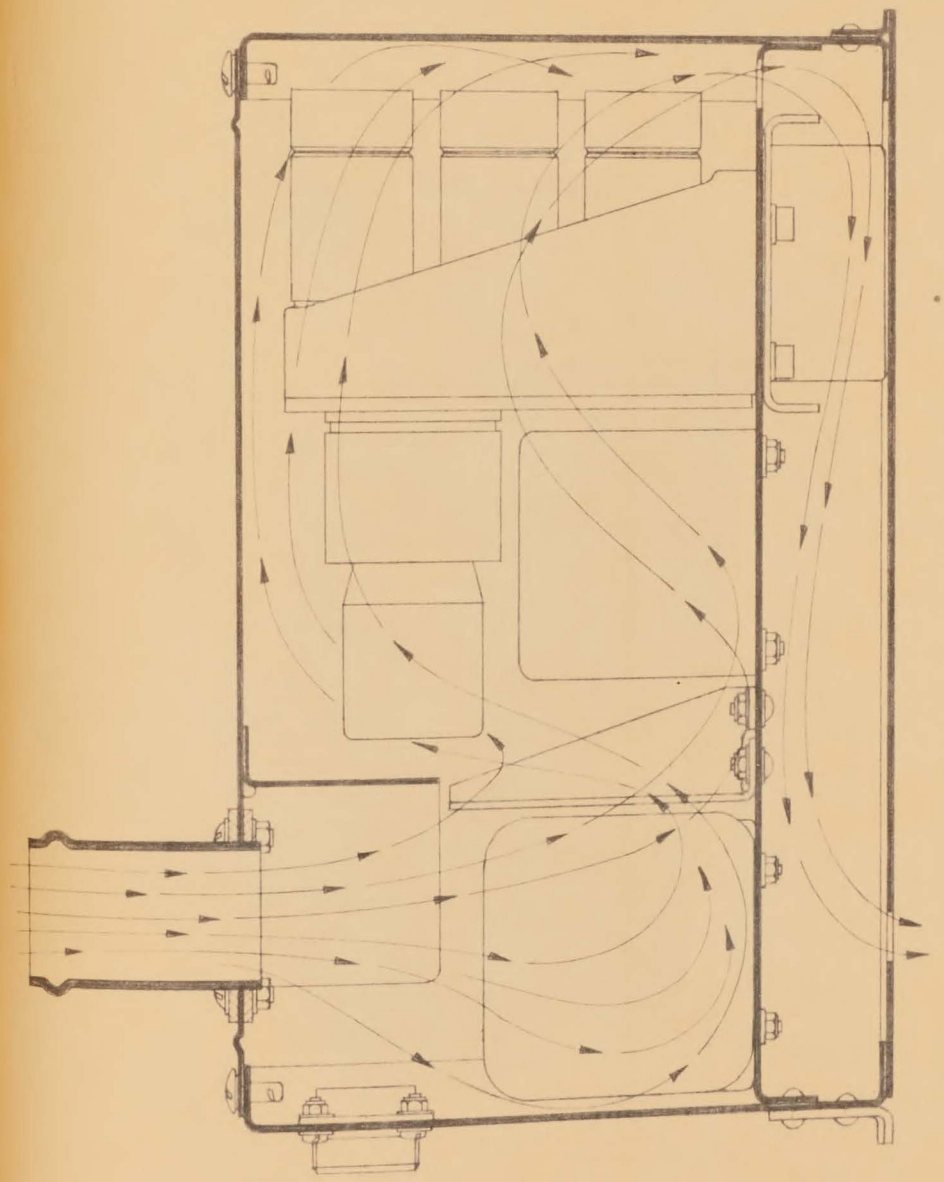
FIG. 1

D-HG 6000A-1 PLATFORM COMPUTER
PLAN VIEW WITH COVER REMOVED

SCALE 3/4 = 1
DEC. 31 - 58

CONFIDENTIAL
UNCLASSIFIED

CONFIDENTIAL
UNCLASSIFIED

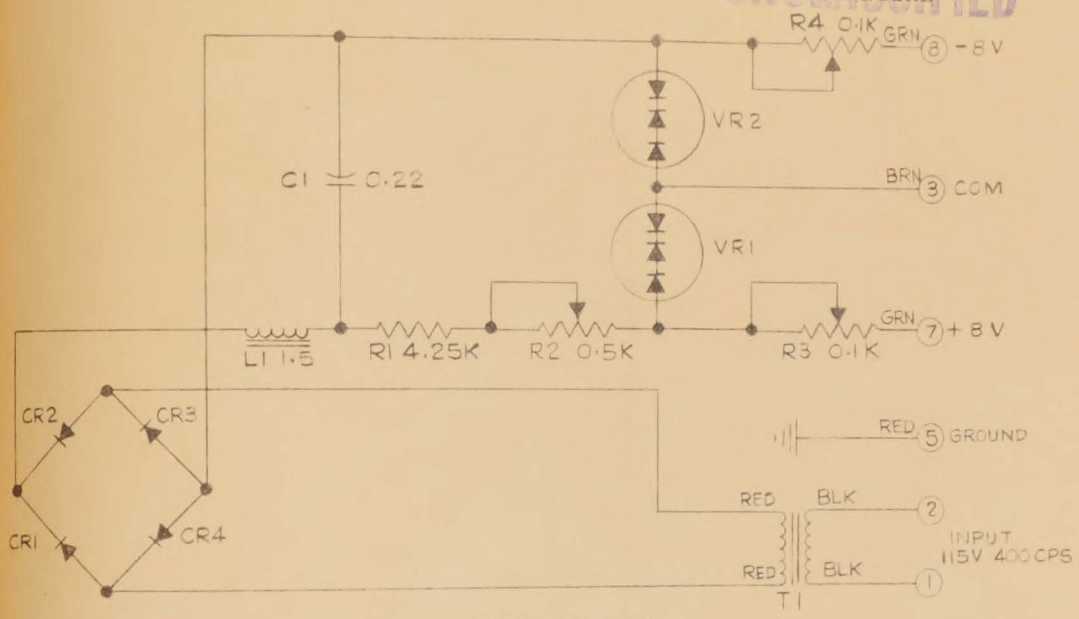


D-HG 6000A-1 PLATFORM COMPUTER - TYPICAL SECTION SHOWING CIRCULATION OF COOLING AIRFLOW

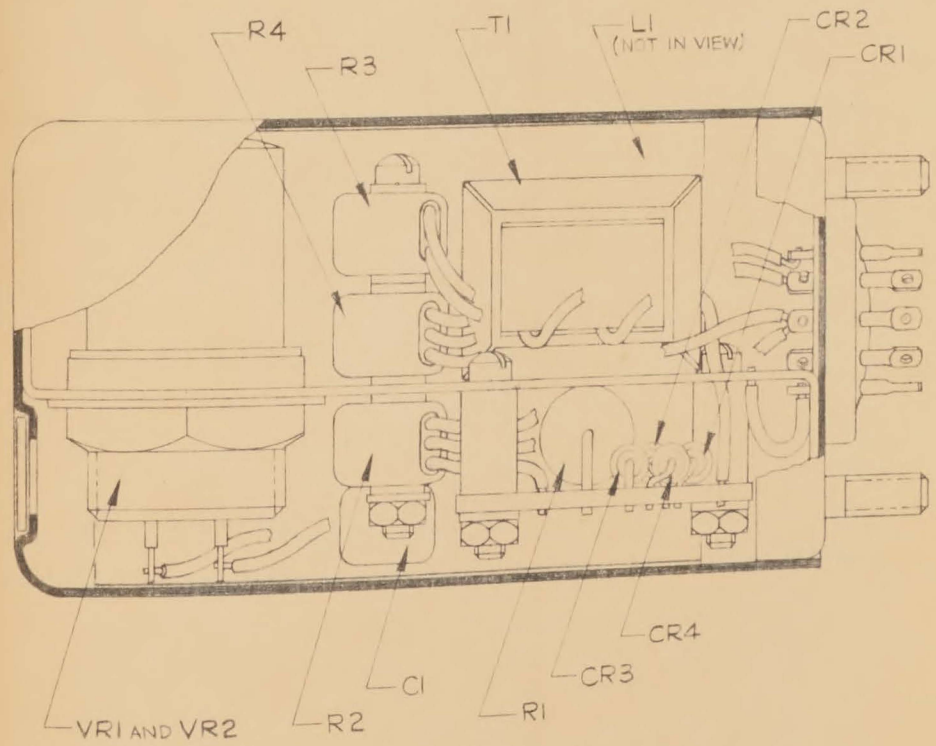
SCALE 3/4=1

FIG 2

CONFIDENTIAL



SCHEMATIC DIAGRAM



POWER SUPPLY ASSEMBLY
PLATFORM COMPUTER

HC/MP Document CR-ED 1067

FIG. 4

SCALE 2:1
JAN 7-58

CONFIDENTIAL


HONEYWELL