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ARROW-FT/13
PROPOSAL FOR A STANDARD
INSTRUMENTATION PACK
FOR ARROW 2 AIRCRAFT
FLIGHT TEST DEPT., AVRO AIRCRAFT LTD.
UNLIMITED

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J. H. PARKIN
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AVRO AIRCRAFT LIMITED

RESEARCH & DEVELOPMENT (AIRFRAME)

REPORT NO. Arrow/RT/13

SHEET NO. 7

DATE 16/June/58

PREPARED BY T.A. Stenning

PROJECT

Arrow 2

File No: 7-07-12-1

Title: Proposal for a Standard Instrumentation Pack for Arrow 2 aircraft.

UNCLASSIFIED

UNLIMITED

PROPOSAL FOR A STANDARD

UNLIMITED

INSTRUMENTATION PACK FOR ARROW 2 AIRCRAFT

(BASED ON THE WEAPONS/INSTRUMENT PACK)

INTRODUCTION

At the request of the R.C.A.F., it has been proposed that all aircraft scheduled to be fitted with weapons/instrument packs, (commencing, probably with Aircraft No. 25209) should have a pack design which is standardised to the greatest possible extent compatible with the differing programs for each individual aircraft.

In practice, this means that a basic minimum system, comprising items which are likely to be common to all the affected aircraft, will be made a permanent installation. In addition to these items, cabling and space provision must be made for additional or alternative requirements which can be added, (within the overall space limitations of the weapons/instrument pack), for specific programs on specific aircraft.

1. Type Of System

It has been agreed with all parties concerned with the Arrow development program (and particularly with Weapons System development) that any standard system should be designed to I.R.I.G. standards. Basically, this implies a 14 track magnetic tape recorder capable of accepting both "F/M multiplexed" signals on the range of carrier frequencies specified by R.D.B., and P.D.M. information from commutation devices having a standard output rate of 900 samples per second. A "slow P.D.M." facility, involving recording at 1/8 of the regular rate, (112 1/2 samples/second), with suitable adjustment of the Pulse Width dimensions, and playing back at 8 times recording speed into a standard P.D.M. ground station, is also to be provided, although this is not covered by I.R.I.G. Standards.

2. The Basic System (See Schematic)

2.1 Tape Recorder

This is the standard I.R.I.G. tape recorder, having 14 tracks, and capable of being run at 3 3/4, 7 1/2 and 15 ips in addition to the standard I.R.I.G. speeds of 30 and 60 cps.

The recorder and its associated electronics form a sub system into which a variety of combinations of continuous and commutated inputs can be fed.

2.1 Tape Recorder (continued)

For example, for most weapons system application the recording speed will probably be 30 ips, allowing a combination of 900 s/s P.D.M., and F/M recording of RDB channels up to No. 16, (40 Kcs). The recording duration in this case would be 24 minutes. If it were required to cover the whole duration of a flight, (say 90 minutes), the tape speed would have to be reduced at least to 7 1/2 ips, (giving 96 minutes), and at this speed Standard 900 s/s P.D.M. could not be recorded. It would, in fact, be more convenient to record at 3 3/4 ips, using low speed P.D.M. and playback at 30 ips.

2.2 P.D.M. Sub-System

Within the basic system, (bounded by the full line in the schematic), provision is made for alternative but interchangeable P.D.M. sub-systems, providing for high or low speed commutation, and high or low level signals.

In all cases, the P.D.M. sub-system will be based on General Devices Incorporated mechanical switches and engineered by G.D.I., and it will be possible to mix high and low level commutators, (and possibly high and low speed commutators) in the same sub-system.

2.3 F/M Sub-System

Ordinarily, in line with our policy of not providing for more than 100 measurements to be taken on any one flight, we would provide sub-carrier oscillators for up to 40 F/M channels, in modular racks containing sub assemblies consisting of either 5 or 10 oscillators plus a power supply. However, there is a strong possibility that R.C.A. for example, may require an extra tape system, running at a different speed. To allow for this, racking and wiring will be provided for up to 90 S.C.O.'s. This allows up to 40 channels for the extra recorder, plus S.C.O.'s for voice, speed lock, etc., as required. Half of these S.C.O. channels will be wired to the standard recorder and half will terminate in pin connections which will provide inputs into the second recorder.

2.4 Range/Time

A Hycon Eastern Airborne Range/Time Generator will be standard, but provision will be made for its replacement, when requested, by a Range Time Receiver, to receive time signals transmitted from a ground station.

2.5 Miscellaneous Services

Such facilities as calibration, precision voltage and frequency supplies, remote control, power distribution, etc. are part of the standard pack and are indicated in the schematic.

2.6 Flexibility

No provision is made for patching signals within the basic system. The fact that 165 commutated channels are provided and that the ground station allows us to select up to 90 of these indiscriminately from any of the three commutators, allows selection and rearrangement of signal channels to be done in the ground station where patching errors can be rectified at the cost of re-running the tape, rather than in the aircraft, where patching errors can cause abortive flights. P.D.M. Signal quantities, up to 165 in number, covering a series of programs, will be carried on jumper cables from the transducer termination plugs in the armament bay roof, to pack disconnects which are permanently allocated to their respective commutator segments.

It is visualised that, for some programs, notably R.C.A.'s Astra development, an input patch panel, located in the armament bay roof, will be required.

In other cases, a small patch panel may be provided for the F/M channels only where the number of these greatly exceeds the F/M capacity of the recorders.

An output patch panel, for picking off signals to feed telemetry or oscillograph is not part of the standard pack, but can be connected to the signal distribution box by means of "Tee-in" connectors at which all signal channels are available.

3. Optional Additions to the System

3.1 Fuel Contents

This system is strictly speaking part of the aircraft instrumentation which is located in the pack for space reasons only. It is not envisaged as a definite requirement on any program yet, and extensive provision has to be made in the wing fuel tank area before it can be used.

3.2 Telemetry

Specifications are being issued to various manufacturers for a Telemetry package which will consist of one transmitter only, plus 14 sub-carrier oscillators, one of which (70 Kcs) will be capable of accepting a P.D.M. signal train from any one of the High Speed P.D.M. commutator/keyer combinations.

An alternative package, with a self contained commutator has been considered, but this would imply breaking into the commutated channels immediately downstream of the signal conditioners if the maximum use were to be made of the facility. This in turn means an output patch panel of considerable size within the standard system, and in view of the limited demand for telemetry, the added complication was not considered justified.

3.2 Telemetry (continued)

Re-arrangement of commutator inputs in order to put them, in parallel, on telemetry will therefore have to be made by wiring changes in the "jumper cables" mentioned in 2.6. On the other hand, any of the F/M channels, up to the capacity of the Telemetry sub-system, can be selected individually from the patch panel described in 3.3 below.

3.3 Patch Panel

The small output patch panel is a device which is only added when it is expected that considerable use will be made of the Telemetry and/or oscillograph sub-systems. All the F/M channels, plus the three P.D.M. composite signals, will be available at pin connections on the signal distribution box. As many of these as are required can be routed to the patch panel, from which selections can be made for individual telemetry or oscillograph programs.

When it is anticipated that telemetry or oscillograph will only be required for one or two specific flight programs, the signals can be taken off direct from the distribution box.

3.4 Oscillograph

Inputs to the oscillograph will be obtained in the same way as inputs to the telemetry facility.

P.D.M. at 900 a/s could not, of course, be recorded on oscillograph, but there seems no fundamental reason why slow speed P.A.M., (output from the D.C. amplifier or from a high level, low speed commutator), should not be recorded. Paper speeds would, however, be high, and duration short, and the facility is probably not worth standardising from the point of view of extra cable runs, etc.

Generally speaking, any inputs intended for oscillographic recording would be fed into signal channels normally used for continuous F/M.

3.5 Extra Tape Recorder Sub-System

As stated in 2.3, half of the 90 F/M channels, (with S.C.O. racking provision) are routed in such a way that they can be fed directly to the second tape recorder.

Where two tape recorders are installed, the standard recorder (No.1) will normally be used for F/M plus P.D.M., possibly at low speed, to cover the whole flight duration, while No.2 is run at higher speed to record such transients as are required for "miss-distance" runs, etc. during a weapons system evaluation.

4. Space Requirements

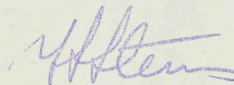
The space available in the weapons/instrument pack, due to certain structural redesign, is slightly more than half that available in the original instrumentation pack.

Preliminary studies by the Product Design Dept. indicated that two Ampax tape recorder systems could be accommodated fairly comfortably, plus 6 Ascop commutator/keyer assemblies, plus fuel contents, plus a reasonable number of S.C.O.'s.

The proposed P.D.M. package occupies much less space than the original Ascop assemblies, and the fuel contents system is a doubtful starter, so that it seems likely that the basic system, plus either Telemetry and Oscillograph or a second tape recorder, can be installed in the space available.

Layout work is in hand to establish the best arrangement of the components for accessibility, and whether there can be space provision for all the optional extras simultaneously.

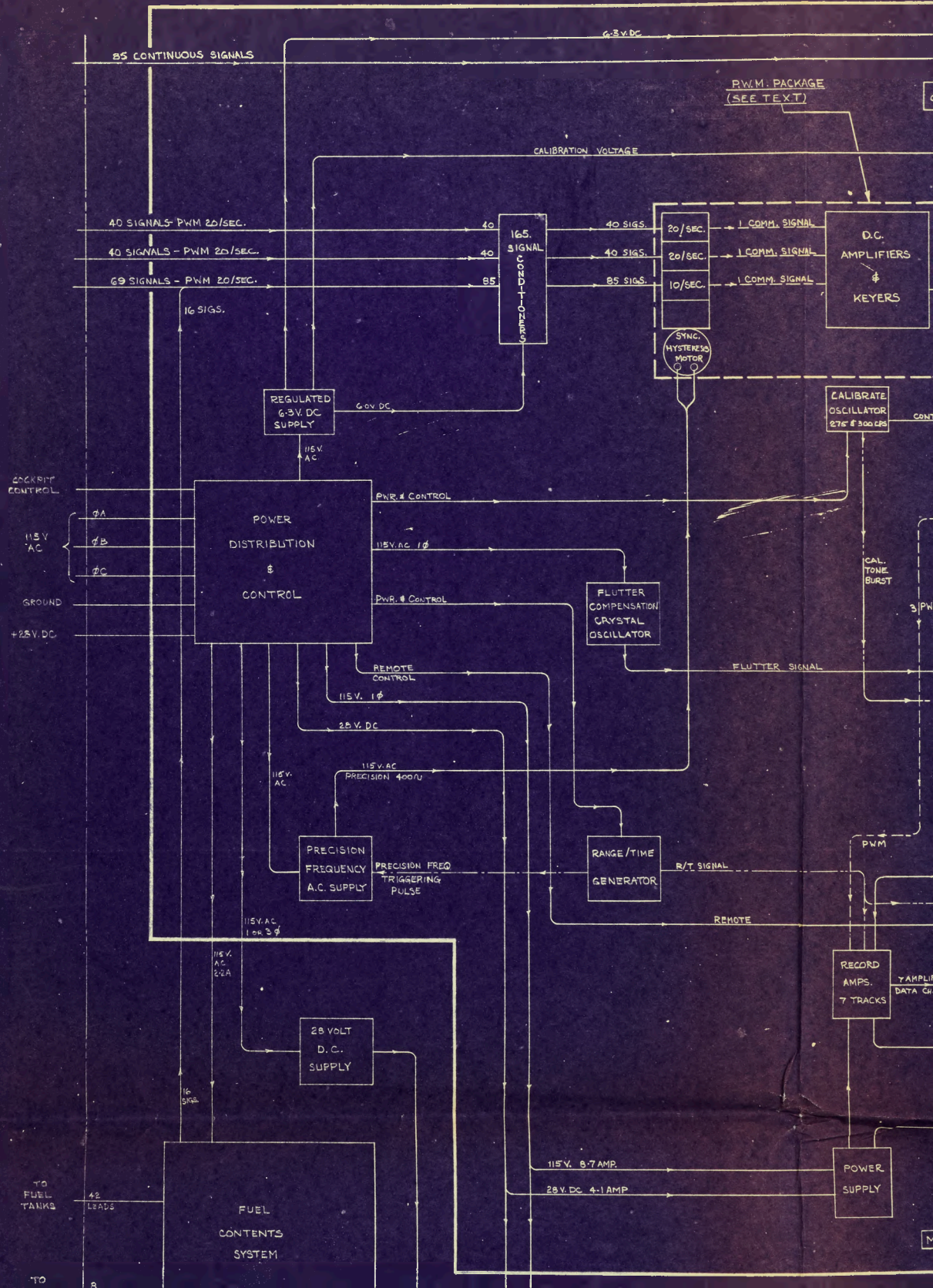
A report on this aspect of the problem will be issued shortly.



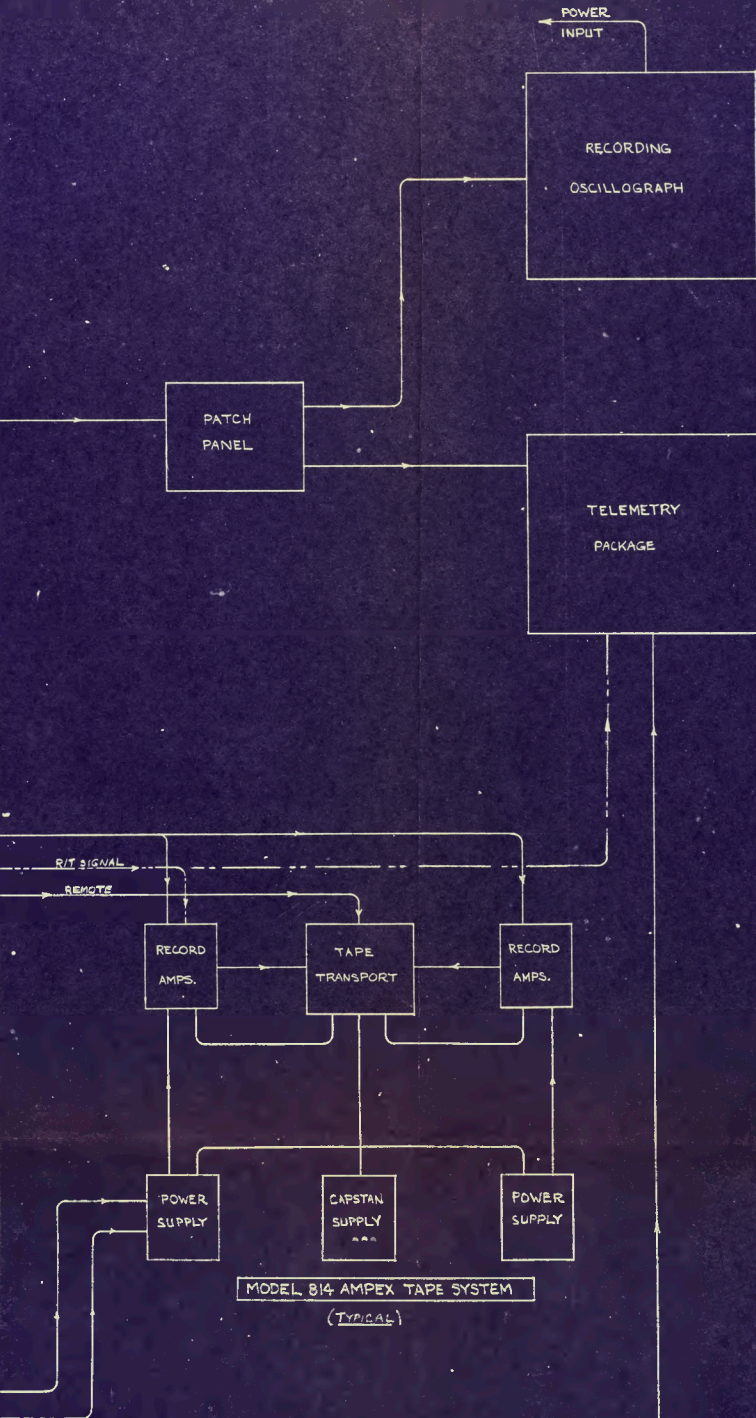
T.A. Stening,

Flight Test Instrumentation Engineering
Supervisor.

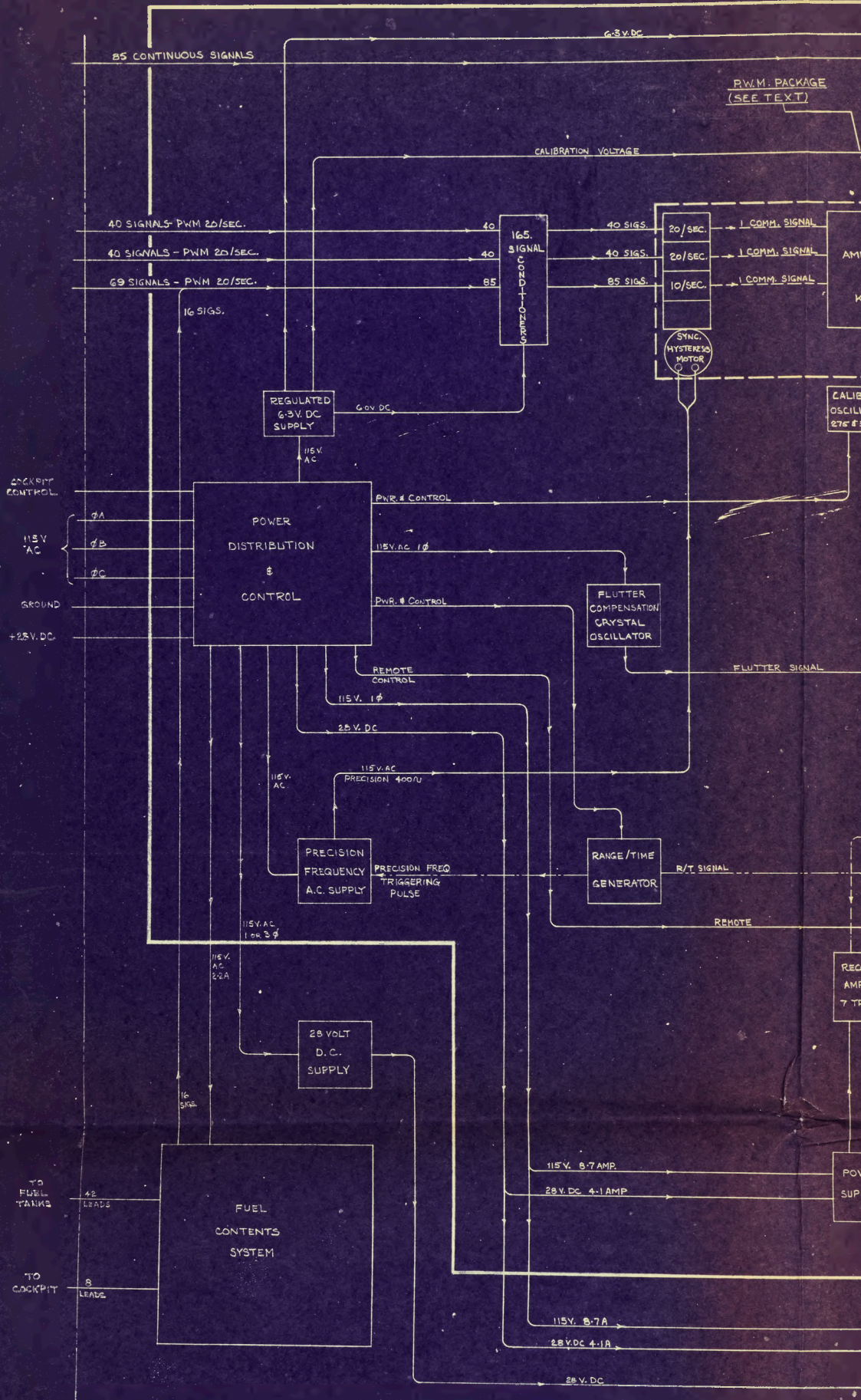
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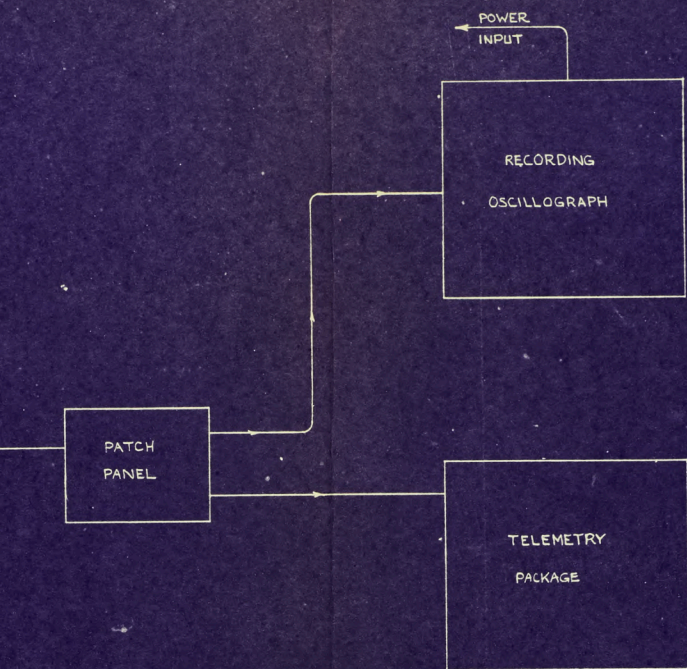
BASIC SYSTEM SHOWN INSIDE
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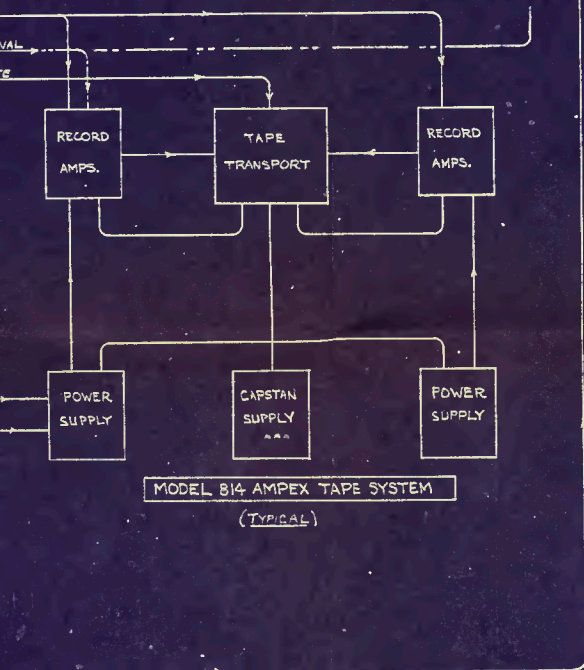
SPARE WIRING AND MOUNTING
PROVISIONS ARE TO BE MADE
FOR ANY ONE OF THESE
SPECIAL ORDER ITEMS.

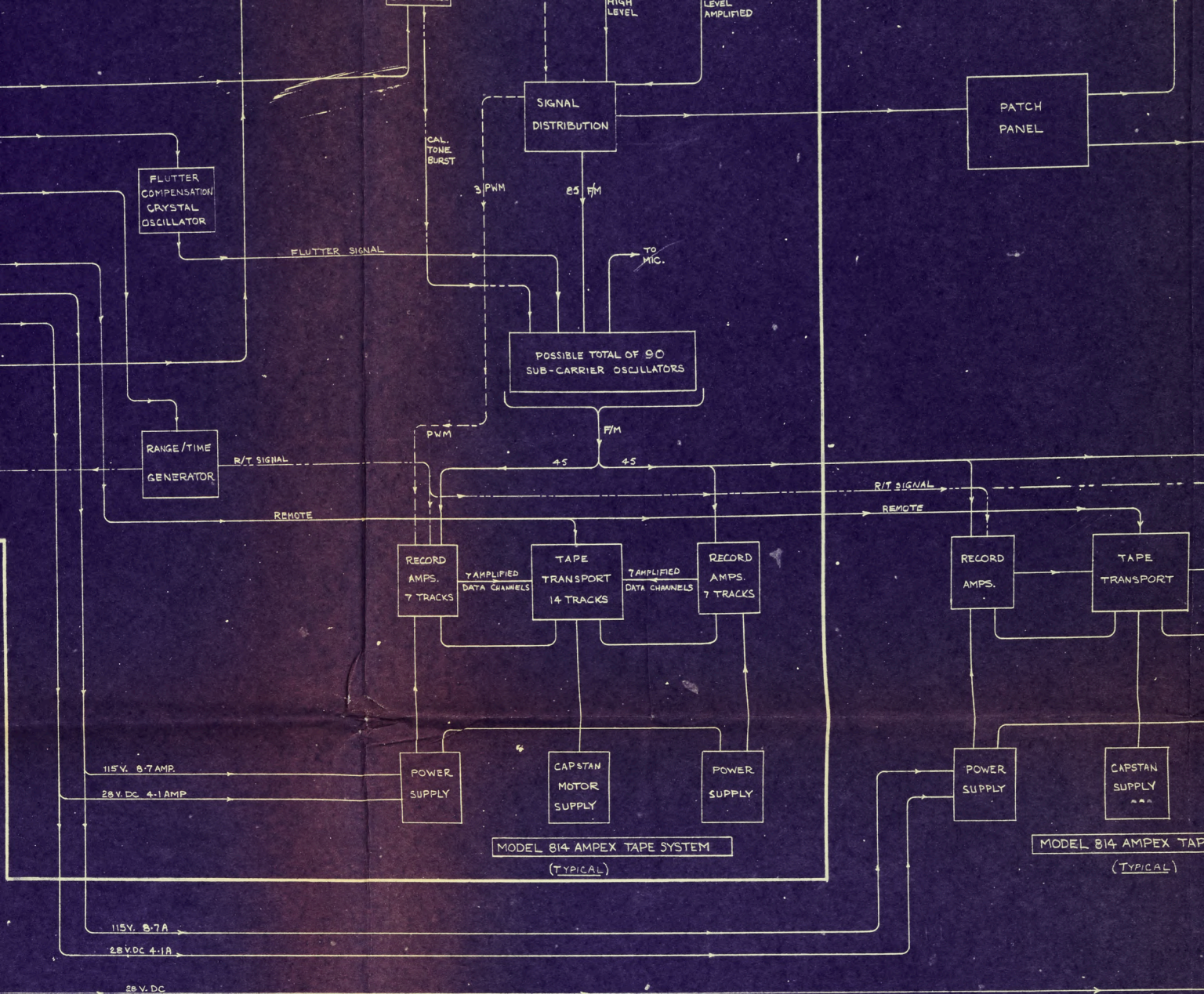


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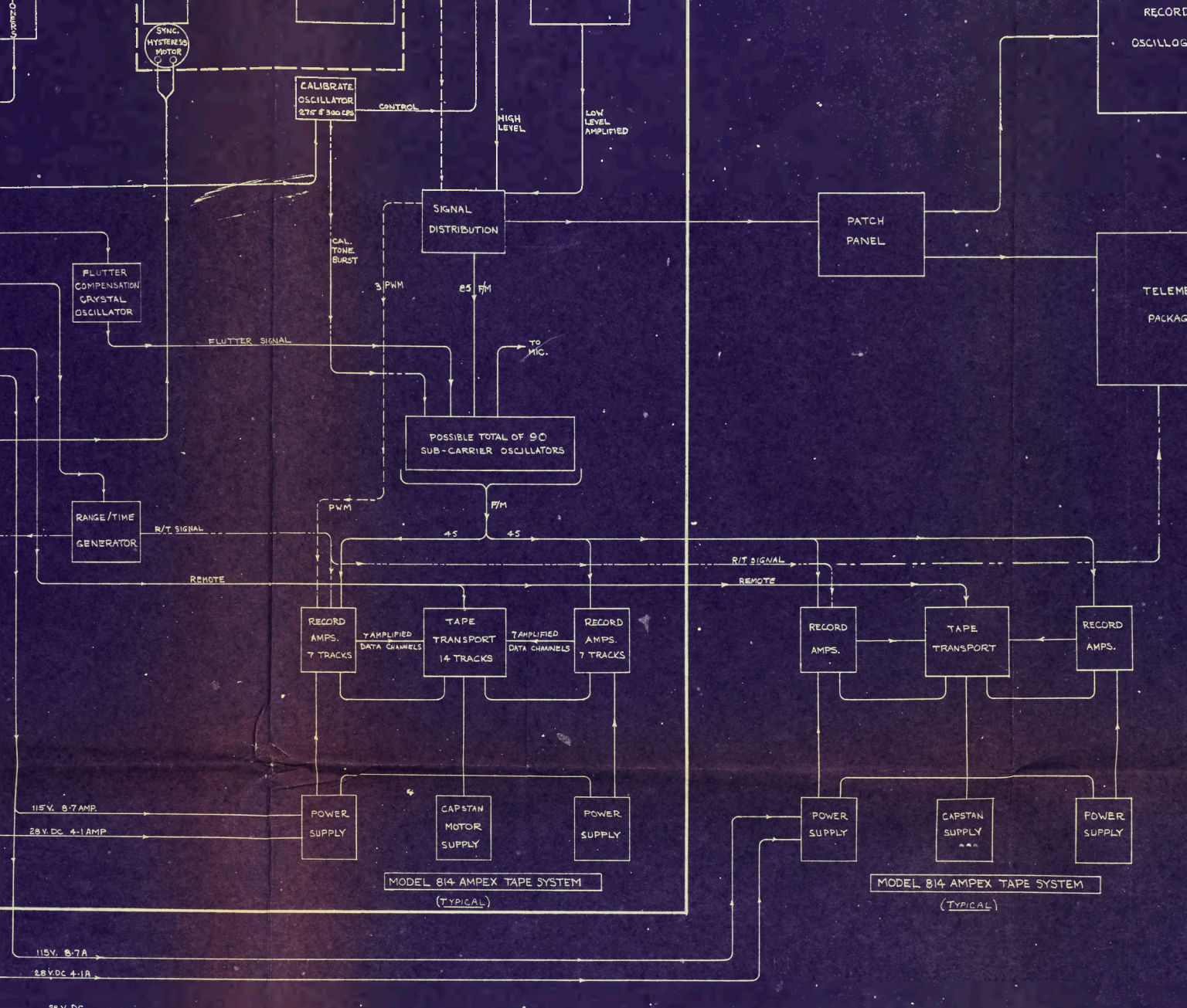




PROPOSED STANDARD I.R.I.G. INSTRUMENT PACK

AIRCRAFT NOS. 25209 TO 14

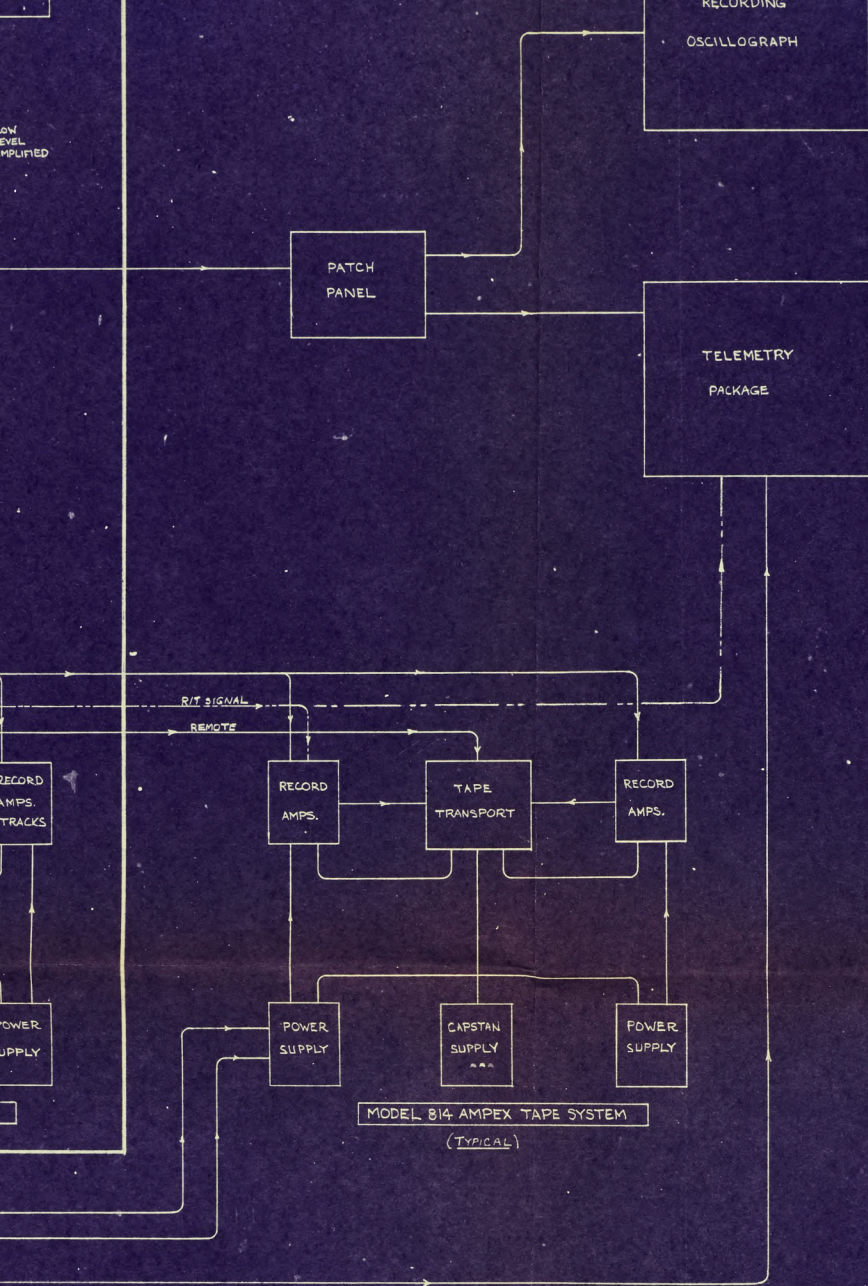
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PROPOSED STANDARD I.R.I.G. INSTRUMENT PACK

AIRCRAFT NOS. 25209 TO 14

HALF SIZE



SPARE WIRING AND MOUNTING PROVISIONS ARE TO BE MADE FOR ANY ONE OF THESE SPECIAL ORDER ITEMS.

INSTRUMENT PACK

09 TO 14

HALF SIZE

AVRO FLIGHT TEST
ENGINEERING

DATE : JUNE 2/55

PREPARED BY : Paul N. Kelly

APPROVED BY :

COLETTA
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MADE IN U.S.A.