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SYSTEMS GROUP CHAIRMAN'S FACTUAL REPORT
ATTACHMENT 5
KOREAN AIR POST ACCIDENT TESTS

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(4 pages)

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KOREAN AIR TESTS

Korean Air-ILS System Test Results

Following the Korean Air Flight 801 accident, Korean Air devised and performed a series of tests on various ILS receivers to determine the effects of extraneous signals on the ILS equipment. The NTSB, Boeing, and Rockwell Collins did not participate in the testing; however, the test methods and results were provided to all accident investigation parties.

A 335 MHz test signal (ILS frequency of 110.3 MHz), -90dBmw, 120 Hz modulation at 100% was applied to the ILS receiver under test while the glide slope indicator and flag were monitored for movement. ***Reference Figure 1 of block diagrams for test setup.*** The following results were noted:

Receiver	Glide Slope indicator deviation	**Flag**
51RV-5B	-58 mV	out of view
51RV-1	-5 mV (centered)	out of view
51RV-2B	-58 mV	out of view (at 270mV)
ILS-70	-1.01 v	out of view
RIA-32A	n/a	in view
ILS-700 series	n/a	NCD (no computed data)

The test was repeated with the same results using a radio transmitter powered by a full wave rectified DC with the oscillator frequency set at 83.75 MHz (one fourth of 335 MHz). ***Reference Figure 2 of block diagrams for test setup.***

The test was repeated on an airplane on the ground with 120 Hz pulsating current feeding the RF signal generator. ***Reference Figure 3 of block diagrams for test setup.*** The indications recorded were:

VOR tuned to 115.3 MHz, course set as 063: NAV capture
NAV tuned to 110.3 MHz: LOC, GS flag out of view
LOC Center, GS 0.8 Dot up
FD Green NAV. White GS

Rockwell Collins response to Korean Air Tests

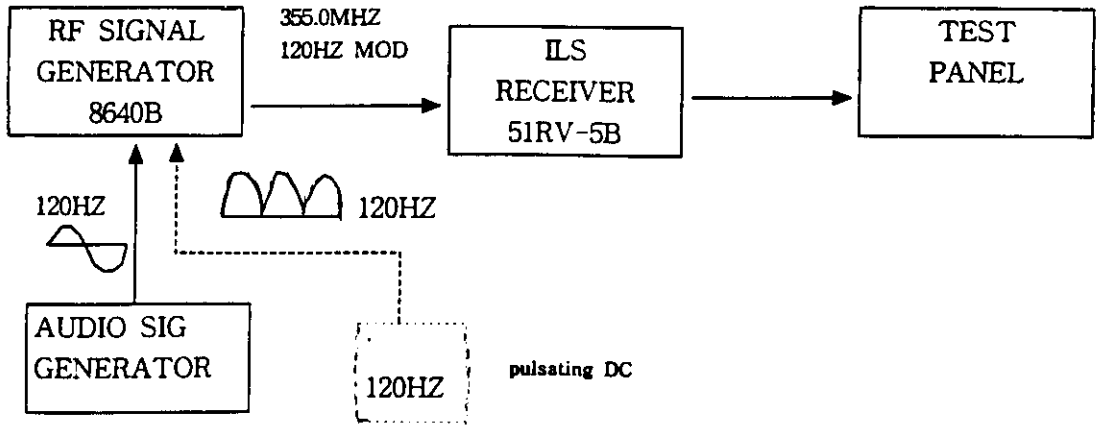
Rockwell Collins technical specialists evaluated the performance of the 51 -RV5(B) according to the test defined by Korean Air and responded in a 19 December 1997 letter from Mr. R.A. Patterson to Mr. S. R. Cho of Korean Air:

> ,.. findings are similar to those of KAL; the receiver response to a single 120 Hz tone, 100 percent modulation at 335.0 MHz is an out of view flag. However this is consistent with the standards to which the product was designed and qualified.
>
> The ILS Glide Slope receiver function of tbe 51 -RV5(B) complies with RTCA DO- 132A which specifies warning flag operation for no tone, reduced tone

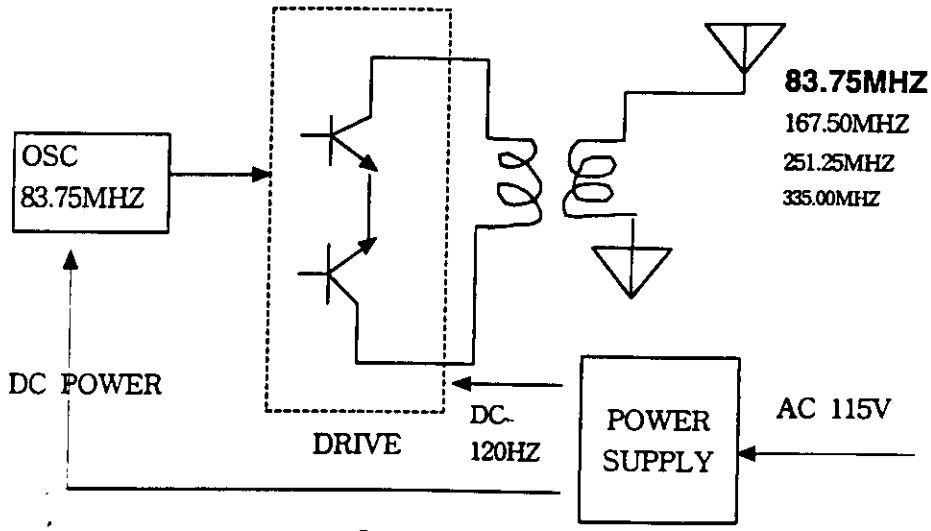
modulation, and loss of tone, These specify that the warning flag shall be in view when one tone (90 or 150 Hz) is maintained at the normal 40 percent level and the other is reduced to zero. The 51 -RV5(B) complies with this specification.

ICAO Annex 10 Appendix 3 provides specifications for ILS transmitter stations. This specification stipulates, that for Glide Slope signals, the depth of modulation of the radio frequency carrier at each of the 90 and 150 Hz shall be approximately 47.5 percent. Limits are set at 45 and 50 percent “in order to achieve the maximum benefit from the airborne receiver flag alarm system.”

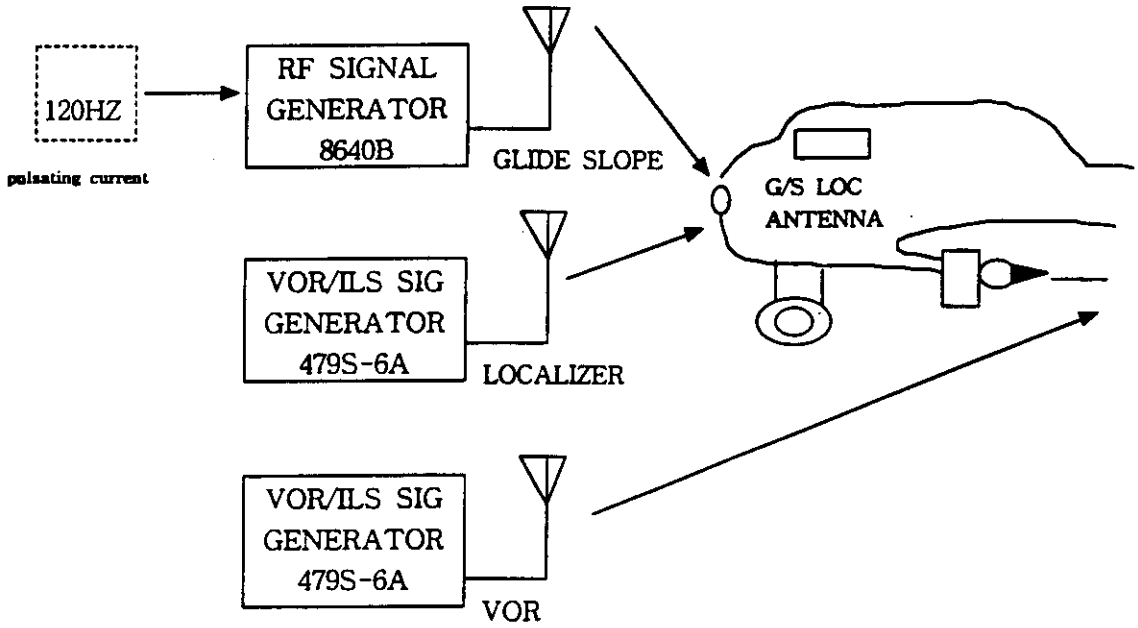
The 51 -RV5(B) implementation employs resistive/capacitive networks filters to detect 90 and 150 Hz tones. When the carrier signal is greatly over modulated, it is possible to couple sufficient energy through these filters to cause the alarm flag to move out of view. The test procedure defined by Korean Air represents a condition outside the specifications for either the transmitter or the receiver.



[Fig 1]



[Fig 2]



[Fig 3]

Korean Air ILS Test Block Diagrams