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**Radio Interference with Minicomputers
and Minicomputer Peripherals**

Wayne E. Kesling

October 7, 1977

Monsanto

MOUND LABORATORY

Miamisburg, Ohio

operated by

MONSANTO RESEARCH CORPORATION

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for the

**UNITED STATES ENERGY RESEARCH
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Abstract

RF bypass capacitors were added to the Head Position Preamplifier and Servo Power Amplifier on Digital Equipment Corporation (DEC) RK05 DISK TRANSPORTS, and ground straps were installed between all peripheral chassis and the main frame of the minicomputers to eliminate interference that was generated by hand-held two-way radios operating in the 165 and 410 MHz ranges.

Introduction

On several occasions some minicomputers at Mound Laboratory operated erratically or stopped functioning altogether. It was discovered that the DEC RK05 disk transports initiated head movement without being instructed to do so by the computer, and that interrupt driven software (such as DEC FOCAL) would quit functioning. On two occasions the glass linear transducer slide in an RK05 was broken. Although it could not be proven positively, it is highly probable that this breakage was caused by the head position motor slamming against the stops when triggered by a radio signal.

Observation revealed that the problems were being caused by two-way radios operating in the 165 and 410 MHz ranges. The specific units that created these problems were hand-held 5-W Motorola Model HT-220 units.

Solution

Disc ceramic radiofrequency (RF) by-pass capacitors were added directly across the input pins of most of the linear amplifiers on the HEAD POSITION SERVO PREAMP and HEAD POSITION POWER AMP boards. These capacitors were mounted on the foil side of the boards, on pins 2 and 3 of the integrated circuits (IC) as shown in Figures 1 and 2 with

minimum lead length. The values used were as follows:

	<u>IC No.</u>	<u>Cap. Value (pF)</u>
PREAMP:	E7 & E11	330
	E6, E9, E10	390
	E12, E13, E14	
POWER AMP:	E1	560

It should be noted that these capacitor values are not necessarily optimum since sufficient time on the systems was not available for a full evaluation. However, they did reduce the amount of RF that reached the inputs of the ICs where it was being rectified and amplified to produce a dc output sufficient to drive the servo motor. The amount of reduction was not enough to stop head movement, and thus, a system of shielding and grounding was implemented as described below.

A system of grounding was installed using 1/4 in., tinned, braided wire. An appropriate point was located on the chassis, frame, and/or cover of every piece of equipment in the system. At this point the paint or anodizing was ground off so that the bare aluminum was exposed in an area large enough to accommodate a #6 or #8 star lock washer. A length of braided wire was fitted with an appropriate size crimp terminal lug and fastened to this point with the proper size bolt, nut, and

*All input bypass capacitors are disc ceramic mounted directly on pins 2 and 3 of the op amp on the foil side of the board with the leads as short as possible.

FIGURE 1 - Modification to DEC PACK HEAD POSITION
SERVO POWER AMP. DEC DWG # H604-0-1.

lock washer through an existing or drilled hole. The lock washer was placed between the lug and the chassis, frame, or cover. The other end of each of the braided wires so attached in the system was connected to a common point on the main frame of the computer system in a similar manner with a #10 bolt of sufficient length to accommodate all the braided wires in the system.

On one system it was necessary to form a piece of copper screen wire to fit the plastic window in the cartridge loading door of the RK05 disk transport. The screen was grounded to the transport frame with 1/4 in. braid, which was also soldered to the entire perimeter of the screen.

All cabinet side panels and doors were grounded in a manner similar to the equipment chassis, frames, and covers.

Conclusion

Of the five systems so modified, every one functioned reliably when the radio transmitters were operated at a minimum of 5 ft from the computer. One system operated reliably with the transmitter less than 1 ft from the computer. This system previously failed with the transmitter operated 15 to 20 ft away. The most sensitive system, which functioned reliably after modification with the transmitter approximately 5 ft away, previously failed with the transmitter at a distance of 25 to 30 ft.

It has, therefore, been demonstrated that the minicomputers can be made to operate with a high degree of reliability by applying a proper system of grounding and shielding and by sensible operation of the two-way radio transmitters.

*Disc ceramic capacitor mounted directly on pins 2 and 3 of E1 on foil side of board with leads as short as possible.

FIGURE 2 - Modification to DEC[™] PACK HEAD
POSITION SERVO POWER AMP. DEC DWG # H604-0-1.

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