FACILITIES INSTRUCTIONS, STANDARDS,
& TECHNIQUES

Volume 3-15

FIBER OPTIC ARC DETECTOR

FIBER-OPTIC DETECTOR

Severe arcing from brushes on hydroelectric generator rings has occurred on several Reclamation generators. If this arcing is not detected soon after it develops, the arc travels between the brushes and may cause considerable damage to the collector rings and brush holders. If this situation were to be unnoticed, as it could be in an unattended plant, it could cause a fire in the generator. Therefore, unattended plants need the protection that some method of arc detection could provide.

The following is description of the latest arc detector as of June 1991, prepared by the developer[1]. Figure 1, is a schematic diagram and Figure 2, is a contact copy of the printed circuit card.

SUMMARY OF DEVELOPMENT AND INSTALLATION OF ARC HYDROELECTRIC GENERATOR EXCITERS

Since the initial development of the exciter arc detectors in 1973, arc detectors have been installed on all hydroelectric generators in the North Platte River Projects and on several generators in other projects. To date, in the North Platte River Projects, several arcing incidents have been detected and the generators successfully shutdown before significant damage occurred.

The arc detector has been modified a few time since it was first developed, and the latest version incorporates some significant changes. The early versions of the arc detector utilized a common photocell or phototransistor and a commercially manufactured fiber optic bundle made to specifications for a specific generator brush layout. These optics worked well for several years, and some original units are still in service. However, due to aging of the fiber optic leads and some damage caused when the fiber optics were removed and the re-installed during generator maintenance, some fiber optics required repair. Because the common end of the fiber optic bundle was cemented together, it was not possible to replace individual damaged leads, and the entire fiber optic bundle has to be replaced with another commercially manufactured bundle.

The latest of the arc detector utilizes individual Hewlett-Packard “Versatile Link” optical receivers and Hewlett-Packard plastic fiber arc cable. A separate receiver and optical cable is used for each brush on the collector rings. The plastic cable can be cut to length, polished, and terminated in the field with the proper crimping tool and an inexpensive polishing kit. The individual fiber optics plug into the optical receivers that are mounted inside a common chassis. The chassis and associated PC board are designed to accommodate up to 16 fiber optics. The cost of the materials, including fiber optics cable, for a typical 16-circuit detector is approximately $300.00.

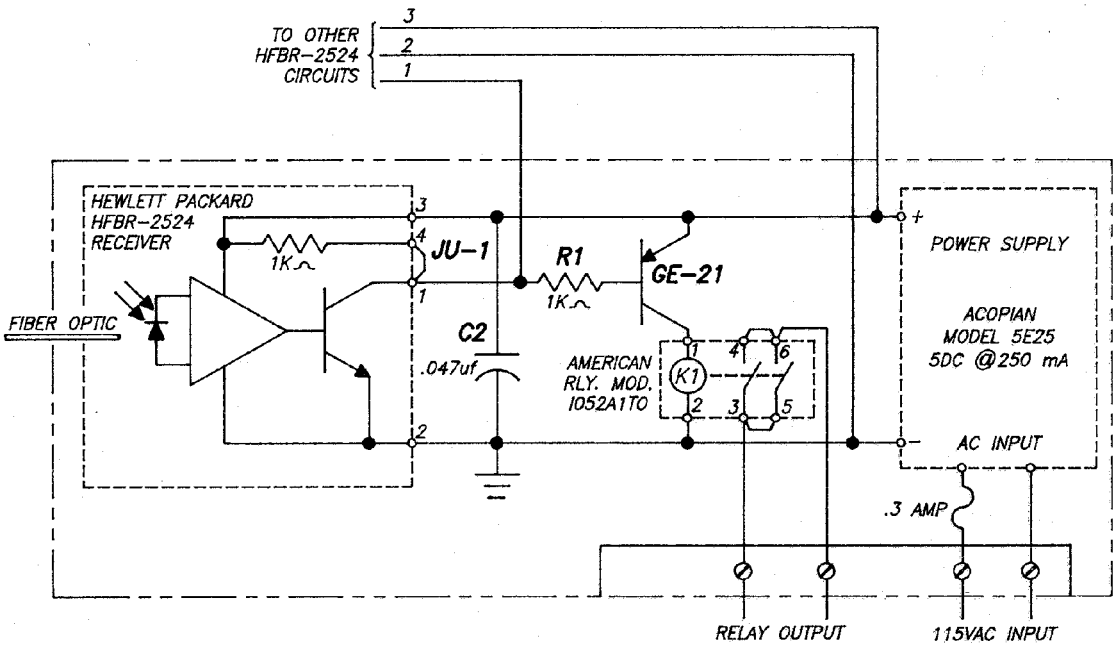
The latest version of the detector had been installed on all of the generators at Guernsey, Glendo, and Alcova Powerplants. These detectors have operated satisfactory for several months. A slightly modified version is being installed at Yellowtail Powerplant. The modified version was designed with more sensitive fiber optic receivers (Hewlett-Packard Model HFBR-2523) that allow one fiber optic to be used for each cluster of brushes. Because of the high sensitivity of these receivers, they can only be used for exciter housings, like Yellowtail’s, that do not allow ambient light form the powerplant to enter the exciter housing.

The use of the individual receivers and plastic cable allows any individual cable to be easily replaced if it is damaged. The plastic cable can withstand a long tern bending radius of 35 mm and temperatures up to 70 ^{O}C.

[1] This arc detector was developed by Mr. Donald Jacobson, Electronic engineer, North Platte River Project Office, GP Region, where additional information may be obtained.

ARC DETECTOR SCHEMATIC DIAGRAM

6/24/91



– NOTES –

1. USE AS MANY HFBR-2524 RECEIVERS AS REQUIRED, UP TO A MAXIMUM OF SIXTEEN.
2. THE COMPONENTS EXTERNAL TO THE RECEIVERS ARE COMMON TO ALL RECEIVERS, EXCEPT JUMPER JU-1 WHICH MUST BE INSTALLED FOR EACH RECEIVER.
3. CAPACITOR C2 SHOULD BE CONNECTED APPROXIMATELY IN THE MIDDLE OF THE ROW OF FIBER OPTIC RECEIVERS AND THE TOTAL LEAD LENGTH SHOULD NOT EXCEED 20 mm.
4. CONSULT HEWLETT PACKARD OPTOELECTRONICS DESIGNERS CATALOG FOR DETAILS ON THE FIBER OPTIC RECEIVERS AND CABLE.

Figure 1. - Fiber-Optic Schematic Diagram.

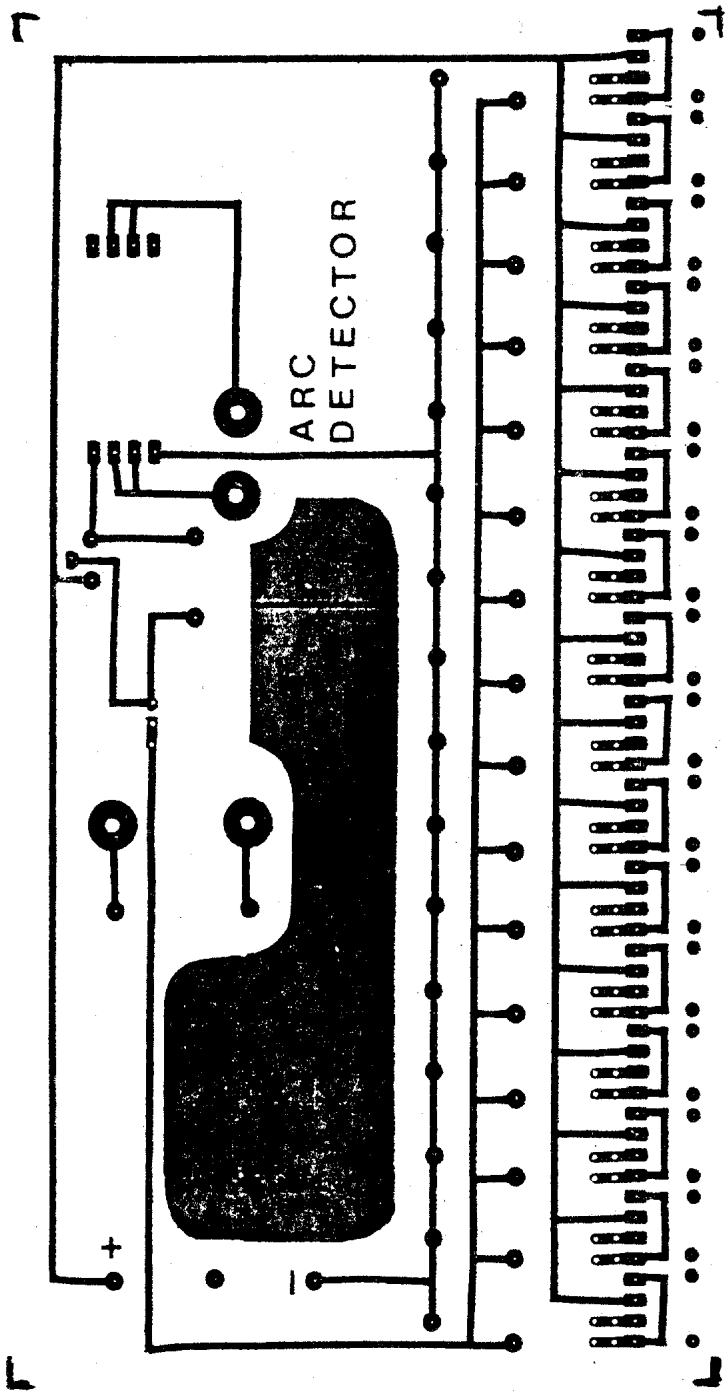


Figure 2. - Fiber-Optic Printed Circuit Board