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# A SOLID STATE VIDEO RECORDER AS A DIRECT REPLACEMENT OF A MECHANICALLY DRIVEN DISC RECORDING DEVICE IN A SECURITY SYSTEM

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**ABSTRACT**

Whether upgrading or developing a security system, investing in a solid state video recorder may prove to be quite prudent. Even though the initial cost of a solid state recorder may be more expensive, when comparing it to a disc recorder it is practically maintenance free. Thus, the cost effectiveness of a solid state video recorder over an extended period of time more than justifies the initial expense. This document illustrates the use of a solid state video recorder as a direct replacement. It replaces a mechanically driven disc recorder that existed in a synchronized video recording system. The original system was called the Universal Video Disc Recorder System. The modified system will now be referred to as the Solid State Video Recording System.

**INTRODUCTION**

The solid state video recording-system software and equipment described in this document has been developed for use in several security projects designed and installed by Sandia National Laboratories, Albuquerque (SNL). The system is known as the Solid State Video Recorder System (SSVRS). The SSVRS consists of a solid state recorder (SSVR), a microprocessor-based SSVR controller, video switching equipment, and associated hardware and software (refer to figure 5). A host computer issues general recording and playback commands to a closed-circuit television (CCTV) controller, which, in turn, issues commands to the SSVR controller. In the remainder of this document, the CCTV controller is indicated as initiating commands to the SSVR controller, but it must be remembered that the host computer controls the CCTV controller, and it is the host that truly initiates most SSVR commands. The host computer/CCTV controller and CCTV controller/SSVR controller communication links are both serial RS-232 lines. On CCTV controller command, the SSVRS automatically records video coverage that occurs during the first few seconds after an alarm. Video coverage from several alarms

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can be recorded simultaneously by use of video multiplexing techniques, and more than one scene from a given camera can be recorded. (The term "scene" as it is used here implies a video recording of eight seconds nominal duration.) Video coverage of one scene can be replayed at the same time coverage of other scenes is being recorded, and video of one scene can be replayed repeatedly to aid the security operator in assessing the course of an alarm.

## ORIGINAL DISC RECORDER

The original video recorder (disc recorder) that was used in this system is very difficult to setup properly and even more difficult to maintain. Among the many maintenance problems that exist are the alignment of the video heads, keeping them aligned, replacing video heads about twice a year, keeping the heads and platter dust free, and replacing the platter. Because of the extreme precautions that have to be taken to insure that the heads and the platter are not damaged, almost all of the repairs that have to be made to the disc recorder are difficult or at the least very tedious. Maintenance on the disc recorder requires a technician that is extremely knowledgeable in both the mechanics and electronic circuitry of the recorder. Also because of the required maintenance, keeping the disc recorder operating is very time consuming. Using the disc recorder on a twenty-four hour a day basis, the mean time between failures usually ranges between twenty-five to forty days.

## MODIFICATIONS MADE TO THE ORIGINAL RECORDING SYSTEM IN ORDER TO INCORPORATE THE SOLID STATE RECORDER

In order to replace the disc recorder with the solid state recorder, it was necessary to make modifications only to the disc recorder controller that exists in the security system and to replace the video disc recorder with the solid state recorder. Among the modifications made to the controller were the elimination of two PC boards and modifying the controller software. One of the eliminated PC boards was labeled Disc Controller and the other was labeled Stepper PC board. The elimination of these two boards also allowed for the elimination of several control lines. Figure 1 (original system) illustrates the system before removing the PC cards and the control lines and Figure 2 (modification to the system) illustrates the control lines (dotted lines) that were removed. The only other necessary modifications that were made to the disc controller's hardware was to add a BNC connector to the controller's chassis

and to add a timing circuit to the VDR Switcher Interface PC board. Adding the BNC connector to the chassis allows the disc controller to receive the odd field pulse from the solid state recorder. The odd field pulse is used in conjunction with the timing circuitry that was added to the VDR Switcher Interface PC board. Figure 3 shows the original circuit of the Switcher Interface board and Figure 4 shows the circuitry that was added (added circuitry shown in dotted lines). Figure 5 (Modified System(SSVR System))shows a block diagram of the modified system in the configuration that it is used in the security system today.

## THE SSVRS HARDWARE

The SSVRS equipment consists of the SSVR, a video routing switcher (VRS), a video character generator, and the SSVR controller. All components are commercially available except the custom-designed SSVR controller.

### The Solid State Video Recorder (SSVR)

The SSVR used in the SSVRS stores video information for subsequent "instant replay" in solid state memory. The video is stored as a digital signal. The capacity of the SSVR is limited to 128 fields, for a total of about 8 seconds of playback. Random-access recording and playback capability provide flexibility in storing and reconstructing video sequences. The SSVR has the capability of reproducing high quality video in either a "freeze-field" or a real time form. Video sequences are stored as scenes, which are orderly collections of video fields recorded in the memory of the SSVR. A scene recorded in the SSVR will not contain all the fields that were generated by the camera, but scenes are always reconstructed to maintain a real-time relationship with the original sequence. Missing fields are filled in as required, and the display may appear as a "stop action" sequence when replayed.

### The Video Routing Switcher (VRS) and Special SSVRS Channels

A Di-Tech Model 5800 VRS is slaved to the SSVR controller to permit high speed switching of the various video signals into the SSVR. This VRS has a dual function capability: (1) control of general purpose video switching via a parallel control buss, and (2) control of special purpose video channels used by the SSVRS. This dual capability permits a single VRS to be used for both SSVR video switching and general CCTV switching.
The SSVRS utilizes two special-purpose channels (or output modules) within the VRS, the recording channel, and the

assessment channel. Each of these channels is directly controlled by the SSVR controller. Data for a switching transaction is set up by the SSVR controller between vertical intervals of the CCTV signal.
The recording channel output is connected to the input of the SSVR and provides field-by-field switching of video to be recorded as selected by the SSVR controller. The assessment channel output is used to feed video selected by the SSVR controller to a fixed input of the VRS; this video can then be selected by the CCTV controller and switched to any desired video monitor at the security operator's console. Assessment channel video may be: (1) live video from the camera named by the CCTV controller (i.e., this video is selected by the SSVR controller if the recording is incomplete), or (2) recorded video from the same camera (i.e., recorded video is selected by the SSVR controller as soon as the recording is complete).

The Video Character Generator

A Laird Model 3302 video character generator provides an elapsed time annotation that is generated by the SSVR controller and displayed as a video overlay to the SSVR output that goes to the assessment channel. The Laird unit is capable of handling remote control commands independent of the video circuits, via a RS-232 serial-communication link with the SSVR controller.

The SSVR Controller

The SSVR controller is based on the Motorola 6809 microprocessor. It performs the following functions:

1. Provides a communication link between the SSVR and the CCTV controller.

2. Executes simplified commands from the CCTV controller to effect multiplexed SSVR recording and playback.

3. Provides all control signals required by the SSVR via a RS-232 port.

4. Allocates memory required for recording according to a dynamic-allocation (multiplexing) scheme.

5. Maintains a data base that includes:
    a. Memory location data for every field of every scene

    b. The number of the first recorded memory location for each scene

c. The starting line for each recorded scene

d. The time from alarm when each memory location was recorded

e. The recorded priority for each memory location

f. The scene owning each memory location

g. The current status for each scene

h. A linear representation of the binary allocation tree

i. VRS-versus scene assignment tables

j. Sizing and timing variables

k. Scene-switching and -splitting variables

l. Replay control variables.

6. Provides hardware interface to the special VRS channels.

7. Provides annotation corresponding to the elapsed time since the alarm for all recorded video output. The SSVR controller includes one SNL-custom-designed printed circuit board. The VRS-control board receives signals from the M6809 microprocessor buss and thereby directly controls the switching transactions of two dedicated VRS modules, the record, and the assessment channels. This board is also used to receive and read the odd field pulse from the SSVR.

## CONCLUSION

The solid state video recorder that is currently being used in the security system was installed in October, 1987, and at the time this paper was published there had not been a single failure. Except for the fans, this recorder has no mechanical parts. When a failure occurs repairing it will probably be limited to replacing a PC board or a power supply. Another attractive feature of this recorder is that even when recording in the field mode of operation rather than the frame mode the video recorded by the solid state recorder is conferrable to the disc recorder.

In conclusion, the only real negative that has been determined about the solid state recorder is its initial cost. However,

the amount of savings that is realized in a short period of time from the low maintenance that is required for the solid state recorder compared to the high amount of maintenance of the disc recorder more than justifies its initial cost.

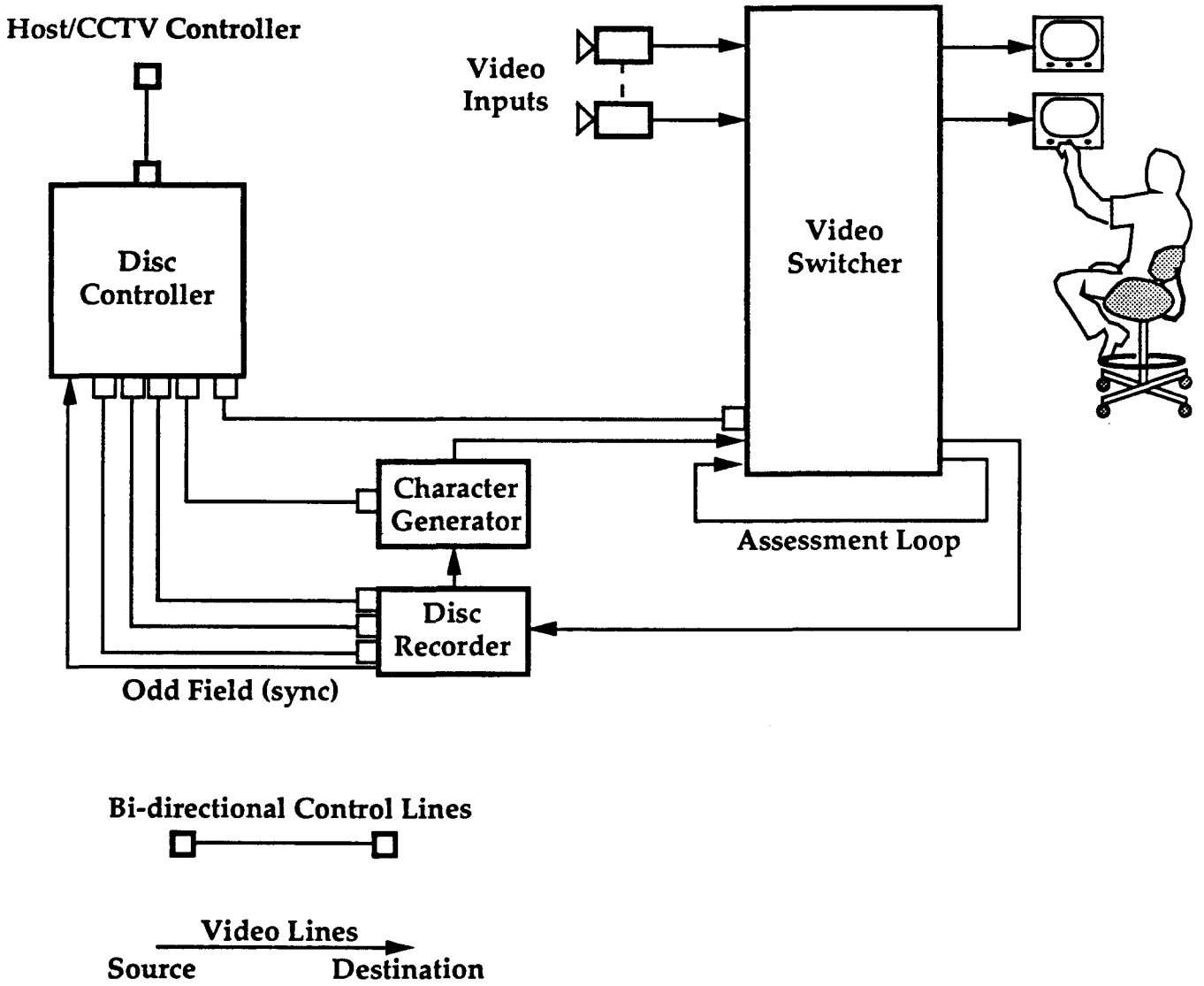


Figure 1. Original System

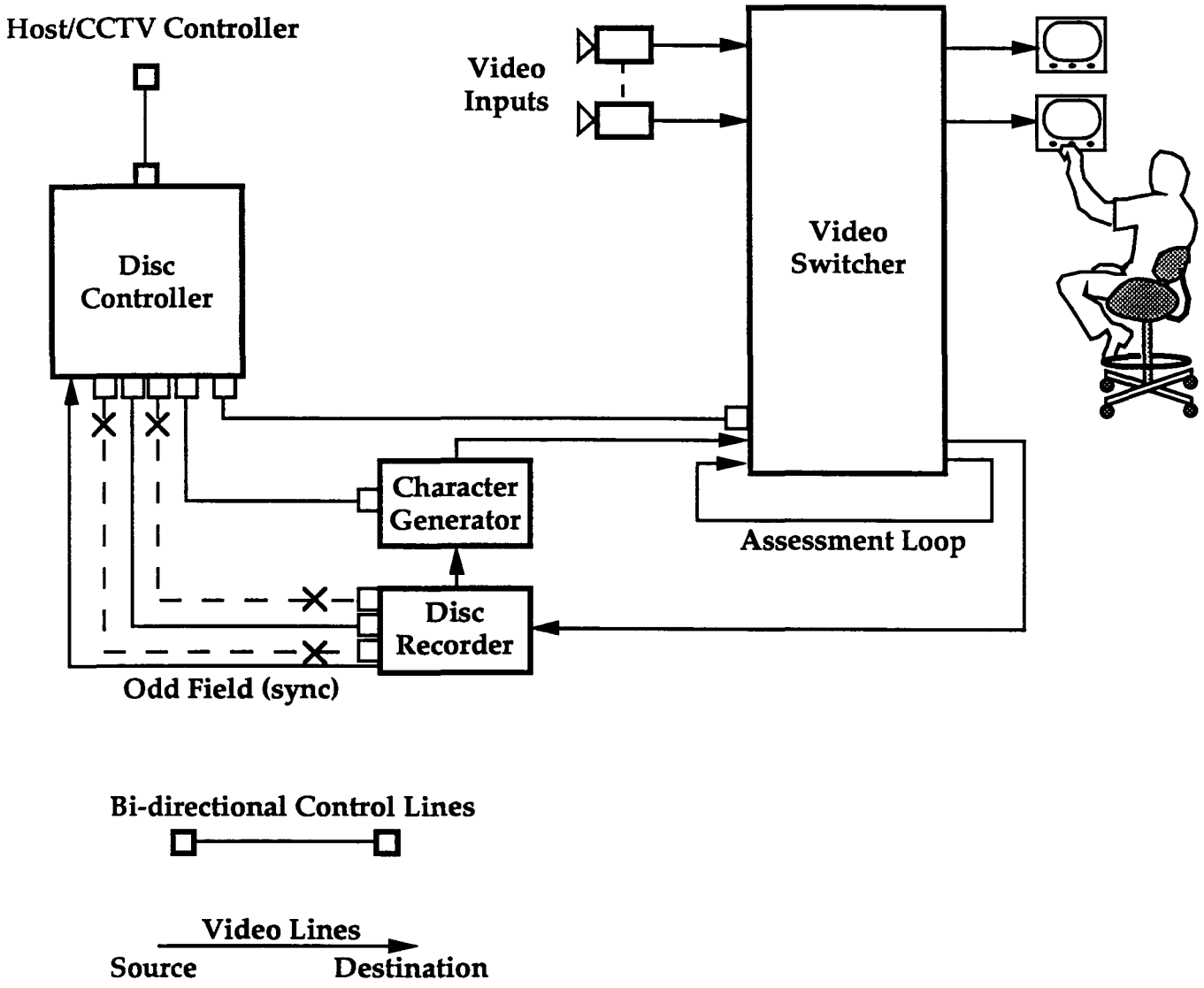


**Figure 2. Modifications to the System**

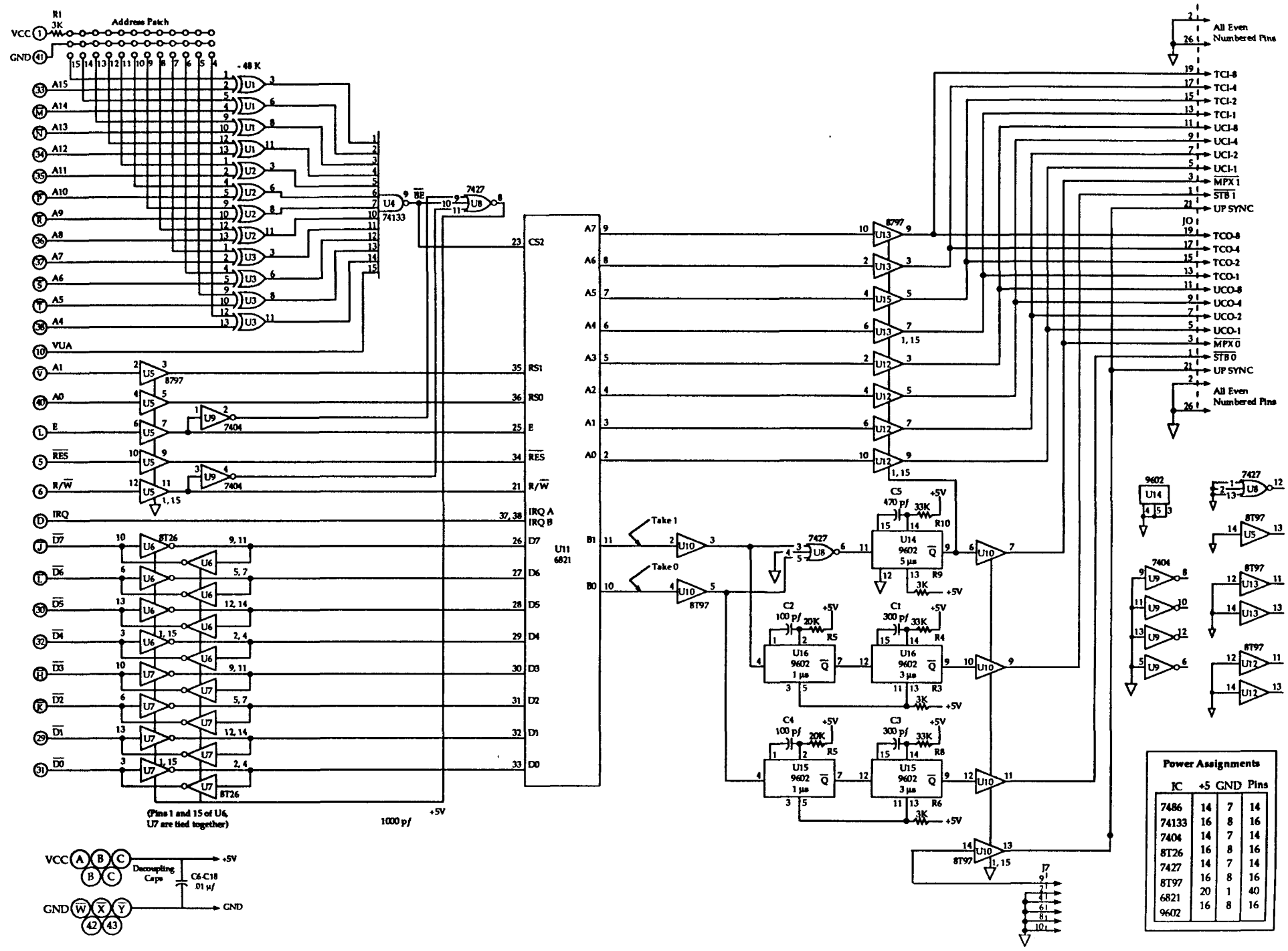


**Figure 3: Switcher Interface PC Board**

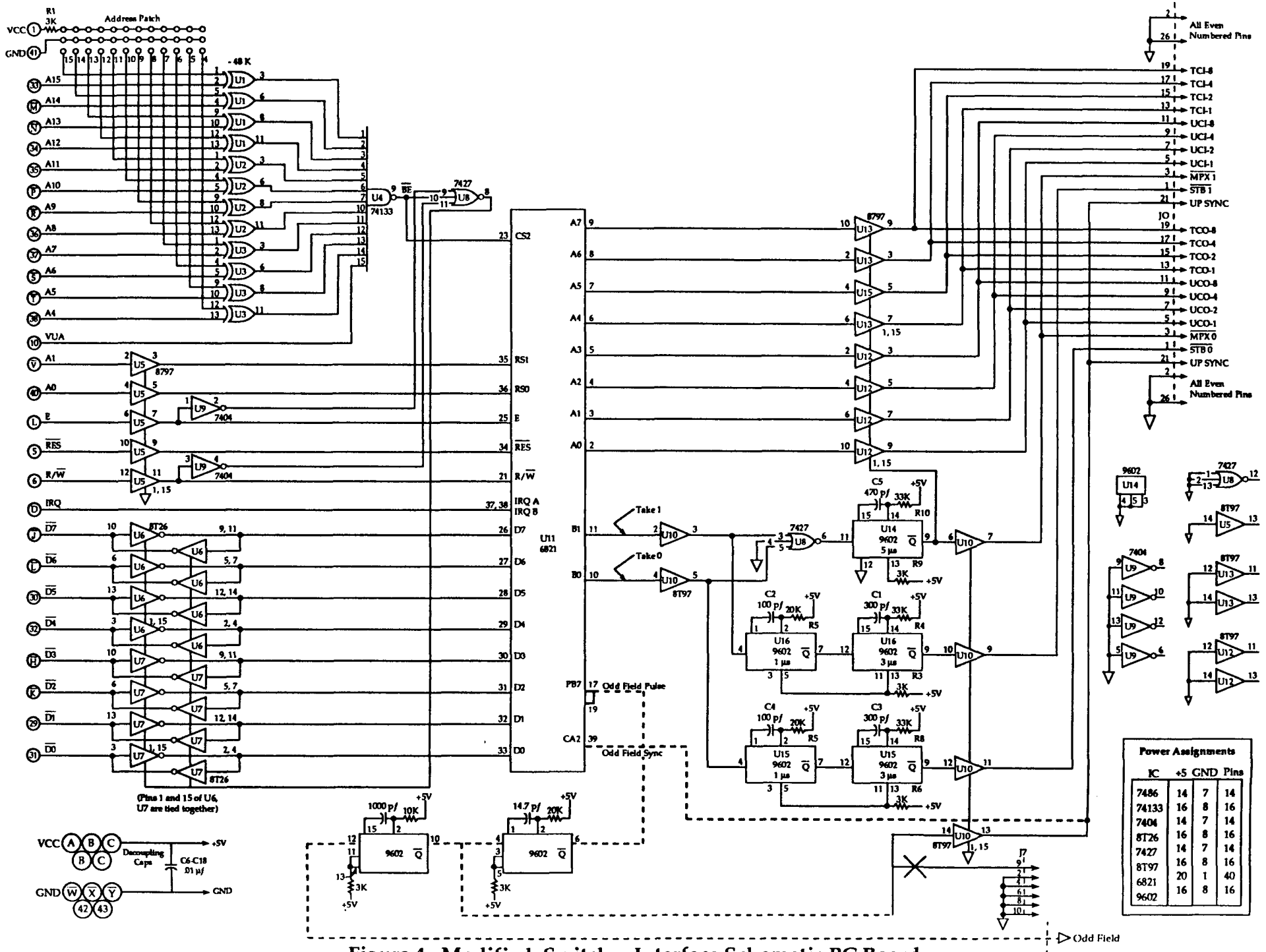


Figure 4: Modified Switcher Interface Schematic PC Board

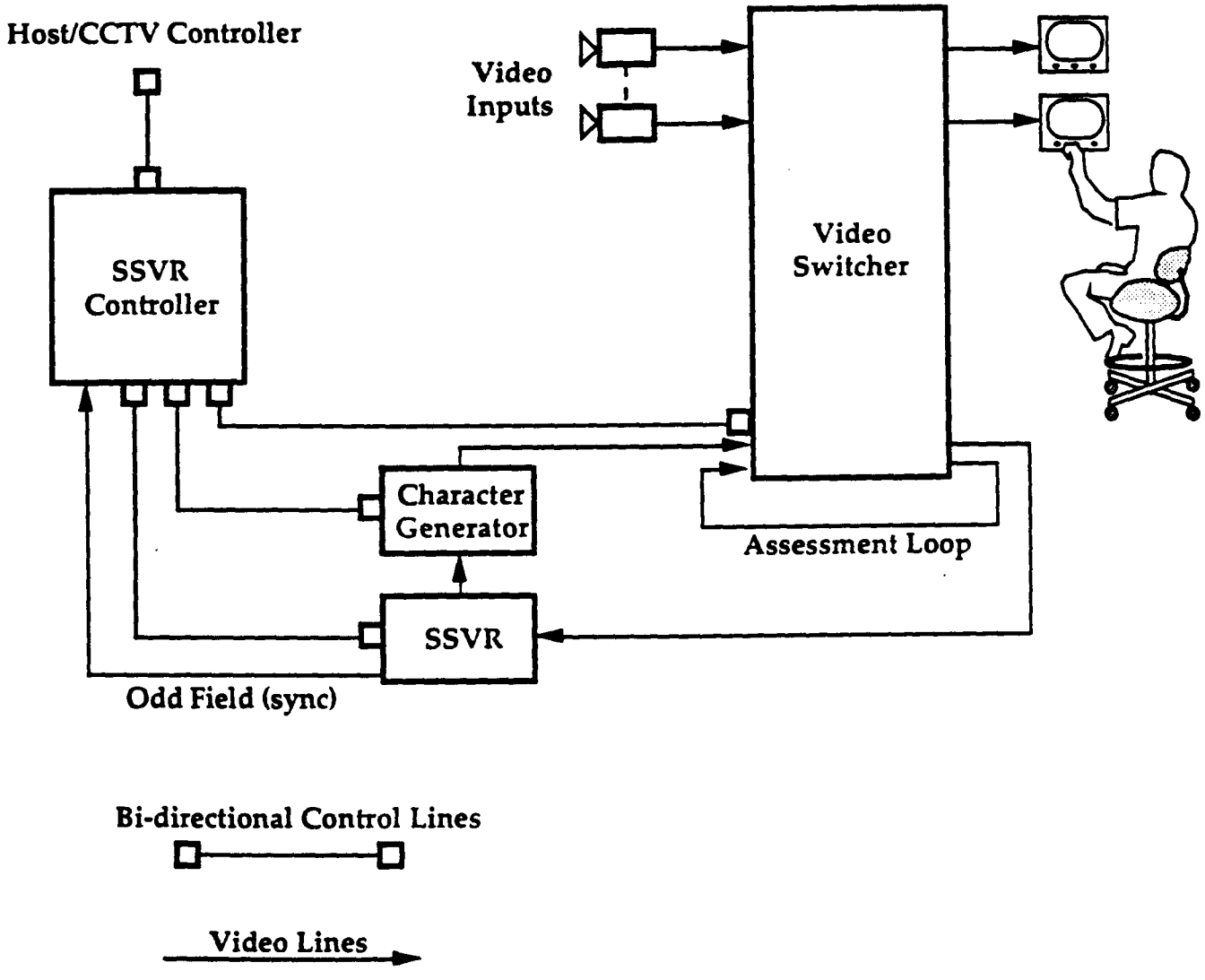


Figure 5. Modified System (SSVR System)