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PEPNET - PEP VIDEO/DATA INFORMATION NETWORK*

W. Struven
Stanford Linear Accelerator Center
Stanford University, Stanford, California 94305

Introduction

The Positron-Electron Storage Ring (PEP) at Stanford has six experiemtnal areas called Interaction Regions (IR's). Each IR has one or two physics experimenters and each experimenter has either a PDP11/780 VAX or similar computer. The PEP Computer Control System also uses a PDP11/780 VAX computer and several Grinnell Video display systems have been interfaced to the PEP VAX. These systems have a number of message panels available which are used in the PEP control room and which would be of interest to the experimenters since they display a variety of operational machine data. The PEP VAX also has a large data base of analog and status signals some of which would be useful to the experimenters.

System Description

We decided to build a video/data information system to carry this information around the 8000 foot storage ring. During PEP construction, a number of 50 ohm cables (RG 213) were installed from IR to IR for general usage as well as some smaller 75 ohm cables (RG 59). The proposal was made to utilize the 50 ohm cables to distribute the video and data

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information. Since all known CATV systems are 75 ohm, we could not use standard trunk amplifiers for distribution. In addition, the loss of RG 213 at the frequencies of interest (channel 3, channel 4 and 74 MHz) were quite high ≅ 30dB/1500'. The IR's are spaced about 1500 cable feet apart and are identified by the numbers on a clock face, i.e., IR2, 4, 6, 8, 10 and 12. The PEP control room (the source of all signals) is adjacent to IR8 (IR12 faces the north).

The system was to be build at lowest cost so we utilized inexpensive MATV Video and Data Modulators at IR8 to launch the signals into the cable in a clockwise direction (see Fig. 1). Amplifiers were built and installed every 1500 feet (each IR) to boost the signal going to the next IR and to feed a signal down to the Experimental area some 100 feet below grade. TV receivers were used to demodulate and display the two video channels and a data demodulator was provided at each IR to furnish 9600 baud asynchronous data to each experimenter's computer. We were able to use standard CATV "taps" (Directional Couplers) but we had to build special 50 ohm amplifiers to provide the gain necessary to offset cable loss. Equalization of the cable "slope" (cable attenuation with increasing frequency) was a problem. We measured 1 dB per 1500 feet difference between TV channel 3 and channel 4. This high slope resulted in some loss of fine detail in the TV picture, two high pass filters were installed one at IR10 and a second at IR2. Some cable equalization is required however, because we found that low frequencies, i.e., (below 30 MHz) did get into the cable (due to lack of adequately shielded cable). This caused amplifier intermodulation distortion and amplifier overload. At a later date we will install two high pass filters at each amplifier (see Fig. 2). This provides the capability of originating signals later at each IR if we launch them below 30 MHz. Return signals therefore, go clockwise just as the PEP signals, but they are separated by frequency using the High/Low Trunk filter or "MUX". This feature also will allow us to adjust the 5 to 30 MHz gain separately with respect to the high band gain, i.e., above 50 MHz (see Fig. 3). We have not utilized this feature but it is a simple matter to add it later. Tap fields were utilized to launch the "Forward" signal (channels 3, 4 and 72 MHz). This feature is shown in Fig. 4.

We have been asked to extend the system to two other PEP buildings which are adjacent to IR10. These runs are similar to the experimenters' cables and do not require extra amplification because of the short runs.

The Video and Data Modulator block diagrams are shown in Fig. 5. This figure also shows the data demodulator block diagram. The data modulator is rather unique in that it uses a non-coherent FSK scheme to send the data. A fast switching diode and band pass filter follow the two crystal oscillators. The effective bandwidth required and spectrum are much like a coherent FM system. The modulator appears to have a modulation index of 10 (the carriers are spaced at 100 kHz).

Operational Problems

Ingress to the system is high on channel 4. We chose channels 3 and 4 because they were adjacent and close enough to 50 MHz to keep the cable loss down. We have a local TV station on channel 4 which causes a "window shade" effect. We moved our channel 4 modulator up a few kHz which reduced the problem, but did not cure it.

We are also bothered, from time to time, with local electrical noise pick-up around the PEP ring from power supplies and other sources. A solid cable would improve this effect and we may go eventually to a solid 75 ohm CATV cable.

System operating levels are kept at about +30 dBmV. We attemped to adjust the video modulator outputs so that the channels 3 and 4 RF levels are just equal at IR2 (half way around the ring). This reduced the intermodulation to its lowest value. Data levels are run about 10 dB less.

Problems have been encountered when switching between a Grinnell (computer driven display) and a TV camera driven display. The horizontal synchronizing frequencies vary by 10 to 15% and the receiver horizontal oscillator will not track. It is difficult to change either source frequency, so we usually provide separate receivers or a receiver with an easily adjustable Horizontal Hold control.

Conclusion

We believe that we have the lowest cost Video/Data Information system for our application and although it has some defects, it seems to serve the need adequately.

Acknowledgements

I wish to thank Bill Pioske, who did a large portion of the system development and installation. Ken Crook and Bob Melen of the I/C Department made many helpful suggestions as the work progressed.

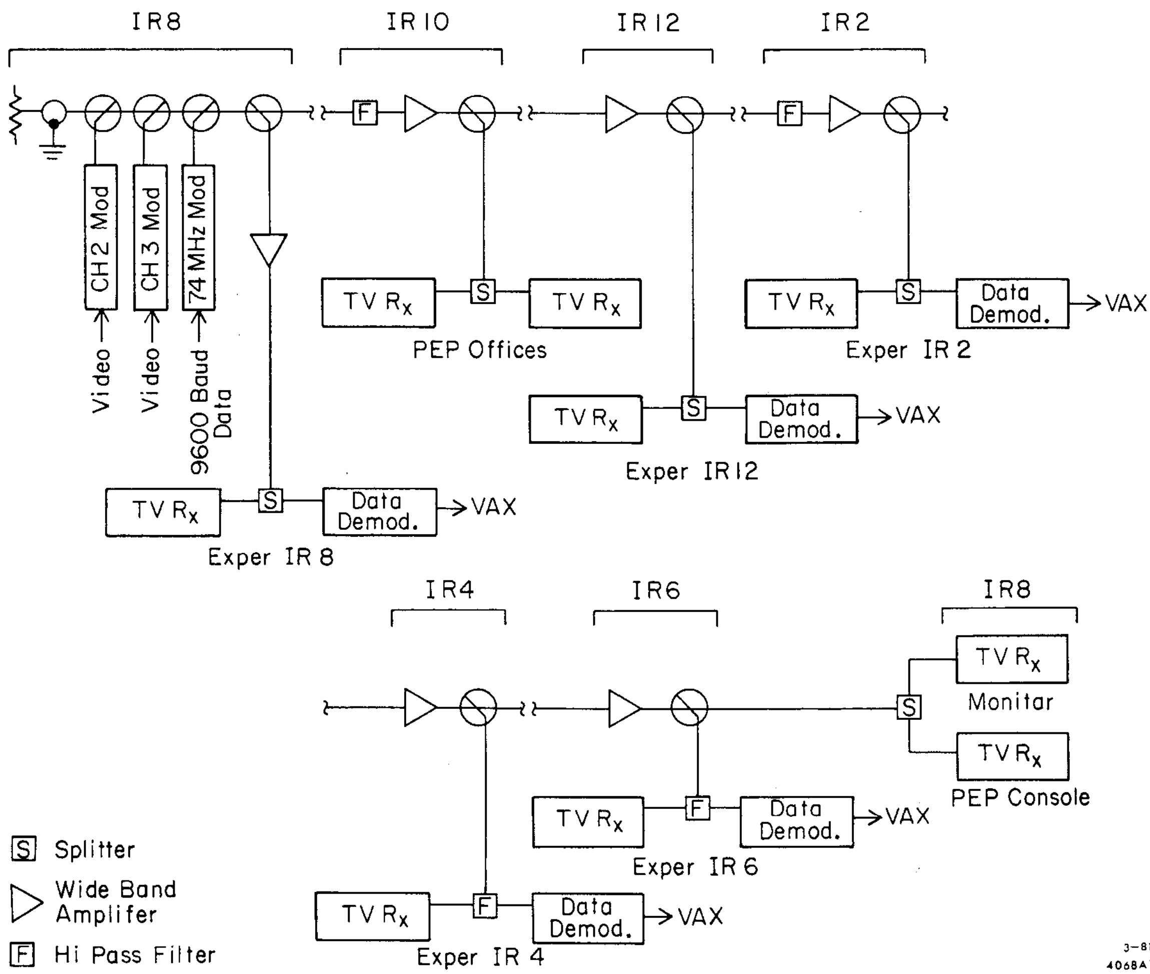
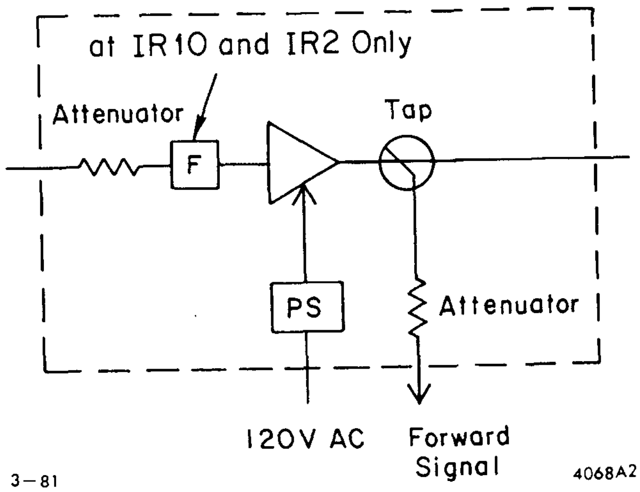
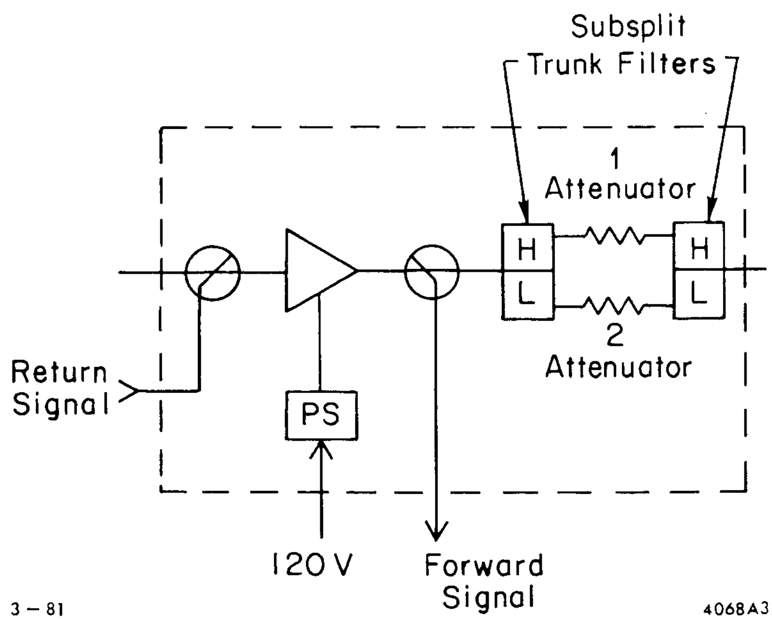

IR8
IR10
IR12
IR2
CH2 Mod
CH3 Mod
74 MHz Mod
Video
Video
9600 Baud Data
TV R_x
S
TV R_x
PEP Offices
TV R_x
S
Data Demod.
VAX
Exper IR 2
TV R_x
S
Data Demod.
VAX
Exper IR12
TV R_x
S
Data Demod.
VAX
Exper IR 8
IR4
IR6
IR8
TV R_x
Monitor
S
TV R_x
PEP Console
TV R_x
F
Data Demod.
VAX
Exper IR 6
TV R_x
F
Data Demod.
VAX
Exper IR 4
S Splitter
Wide Band Amplifer
F Hi Pass Filter
3-81
4068A1

Fig. 1



Present Amplifier System - One Way

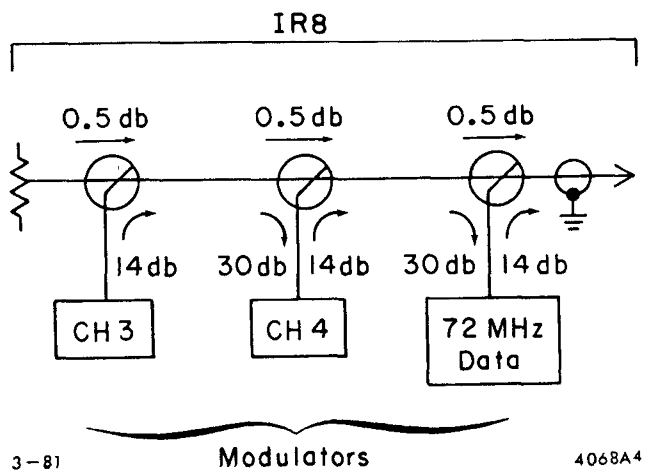
Fig. 2



Attenuators 1 and 2 Used to Adjust Gain of System in Hi/Lo Bands

Future Amplifier System - Two Way

Fig. 3



Tap field is used to isolate modulators from each other therefore reducing intermodulation distortion.

Fig. 4

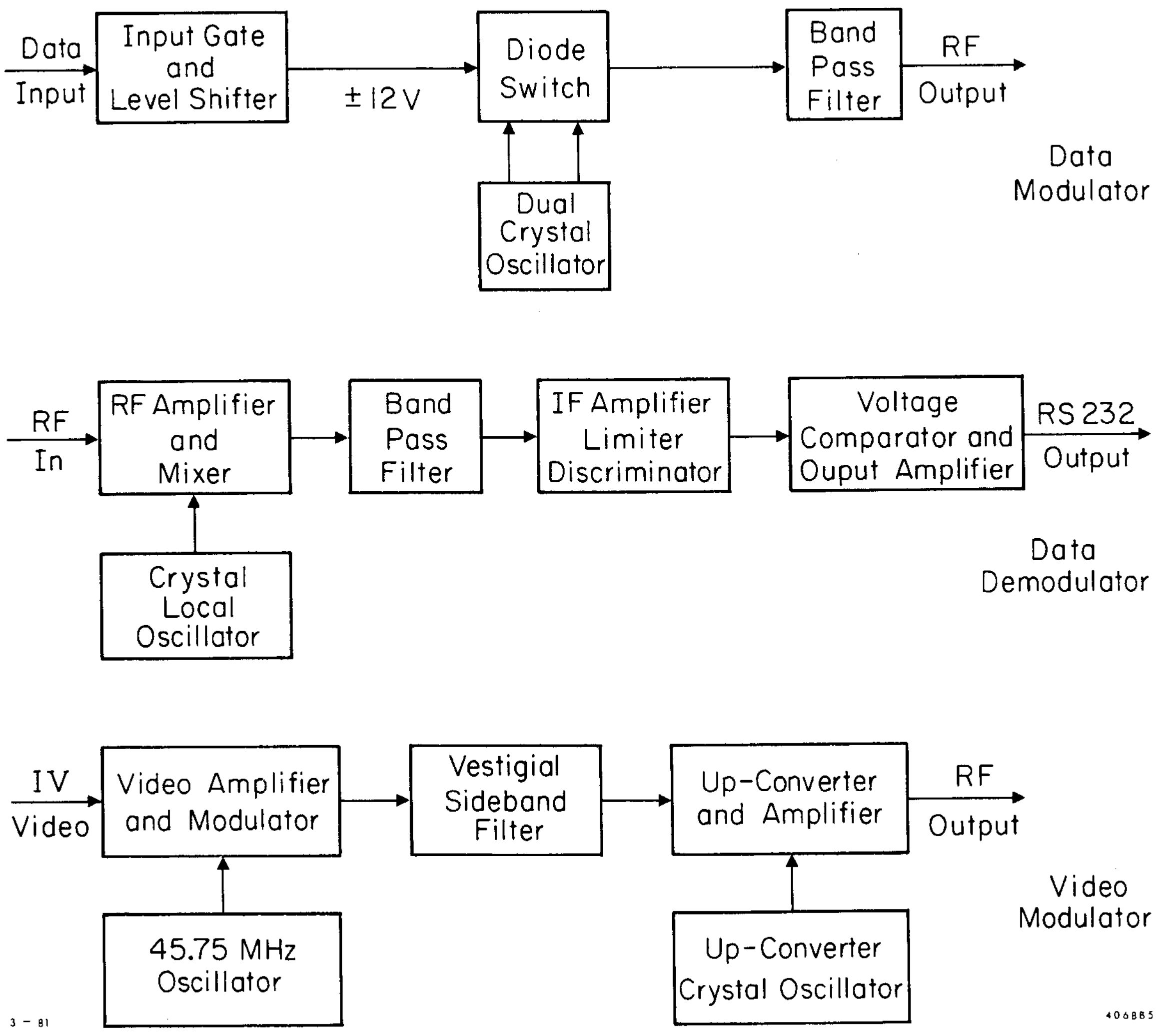

Data Input
Input Gate and Level Shifter
±12V
Diode Switch
Band Pass Filter
RF Output
Dual Crystal Oscillator
Data Modulator
RF In
RF Amplifier and Mixer
Band Pass Filter
IF Amplifier Limiter Discriminator
Voltage Comparator and Ouput Amplifier
RS 232 Output
Crystal Local Oscillator
Data Demodulator
IV Video
Video Amplifier and Modulator
Vestigial Sideband Filter
Up-Converter and Amplifier
RF Output
45.75 MHz Oscillator
Up-Converter Crystal Oscillator
Video Modulator
3 - 81
406885

Fig. 5