IMPROVING RELIABILITY OF CATV SYSTEMS

by

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Much has been done by the CATV industry to assure that CATV subscribers receive high-quality TV signals and that they receive more channels than there is worth-while programming to fill. However, little has been done to assure the subscriber that he will not be entirely without TV signal due to equipment failure.

CATV equipment seemingly prefers to fail during the hours of 5 P.M. and 1 A.M. This is annoying to the subscriber and the system maintenance personnel, alike. While the subscriber waits patiently -- or impatiently -- for the programming to be restored, the system maintenance personnel must respond to these emergencies at a time that can be most undesirable.

These situations could be avoided if the CATV system was self-sustaining through the use of automatic backup equipment, enabling the system to continue operation without interruption, even though an equipment failure has occurred.

The basic design parameters of such a system are:

1. The ability to detect an equipment failure.
2. A method of automatically transferring to backup equipment upon failure of the primary equipment.
3. The ability of notifying maintenance personnel that a failure of the primary equipment has occured.
4. The ability to locate the piece of equipment which has failed.

Let us look at how these functions can be accomplished at the head-end site.

The headend equipment should be designed to prevent failures, as much as is possible with the present state-of-the-art.

Such a system is comprised of partial or full dual equipment for each channel.

This includes dual preamps, preamp P.S., dual bandpass filters, and dual-channel amplifiers capable of automatic change-over to backup equipment, and an alarm system capable of notifying maintenance personnel.

PREAMPLIFIERS

Preamplifiers should be of the single channel type with the greatest skirt selectivity available. The greater the skirt selectivity, the less electrical surge energy reaches the preamplifier's electronics from nearby lightning strikes. The preamplifier must also have maximum protection within its electronics against these surges.

Even with maximum protection against failure due to surges and solid state reliability protecting against failures due to aging, preamplifiers still can fail.

Providing a fail safe system will solve this problem.

Figure #1 shows this setup.

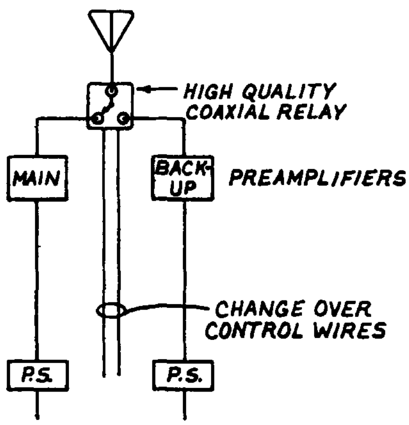


Figure #1

Two preamplifiers are fed from a common antenna. This is usually the most practical method when complex and expensive antenna arrays are used. However, when smaller antenna arrays are used for the stronger signals, a separate antenna for each preamp may be practical and greater reliability against failure can be achieved.

The antenna signal is fed to each preamplifier through a coaxial relay rather than a hybrid splitter to prevent a 3 db decrease in the signal-to-noise ratio, and to provide additional surge protection to the backup preamp in the disconnected leg of the relay.

The control voltage for this relay is supplied from the signal sensing equipment within the headend building.

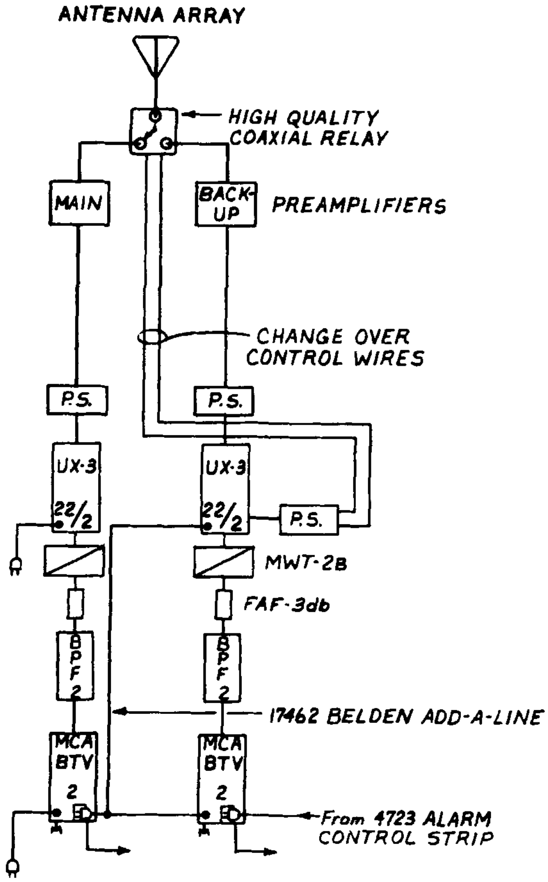
Two coaxial down leads are used to provide additional backup protection in case of coax failure.

The preamplifiers each use identical broadband amplifier boards preceded by a very selective Helical resonator single-channel filter.

Stocking one spare amplifier board allows easy replacement without removing the preamp from the antenna tower.

Each preamp will be connected to its own preamp power supply. These power supplies must have excellent built-in surge protection, especially if they are of the more complex regulated type.

Figure #2



The preamplifiers feed either UHF converters, followed by bandpass filters, or in the case of VHF channels, VHF bandpass filters. As shown in figure #2. Both devices protect against incoming high voltage damage to the headend. The UHF converter - because very little lightning energy is concentrated at UHF frequencies, and the VHF bandpass filter - because little energy is concentrated within its narrow bandpass.

If single-channel sound traps are used to attenuate the sound carriers to the desired level, these traps must be extremely stable to prevent interference with the color sub-carrier. The ideal trap for this use is the adjustable notch depth type. The adjustable notch type differs from the standard types in that the sound carrier level is controlled not by varying the frequency of the trap, but by adjusting the coupling of the trap sections, which in turn increases or decreases the trap depth.

The heart of this improved reliability headend is the MCA-BTV signal processors. This device filters, amplifies, and provides the high AGC range for great variations in input signal level. The high gain AGC DC amplifier makes possible the method of automatically switching to backup equipment if the primary equipment should fail.

The MCA-BTV senses its own output signal and performs two functions if it, its preamplifier, or converter fails.

1. Switches AC power to its AC convenience outlet, which has been wired for "signal on - AC power off," to which is connected the backup MCA-BTV and a small DC power supply which powers the antenna preamp coaxial relay which we discussed previously.

2. Cuts off its R.F. output to prevent noise from being fed into the system by the primary MCA-BTV which is now running at full gain because it has no output signal to provide AGC voltage.

The backup MCA-BTV being turned on upon failure of the main MCA-BTV, instantly replaces the main channel, providing the subscriber with uninterrupted programming. When the backup MCA-BTV "sees" a signal at its output, it knows that the channel has not gone off-the-air, but that the main amplifier, converter, or preamplifier has failed, and switches AC power to its AC receptacle which has been wired for "signal on - AC on" (opposite from that of the primary MCA-BTV.) The Model 4723 Alarm Control Strip, which is plugged into the backup MCA-BTV convenience outlet, uses this voltage to energize a 4 form C relay within the Alarm Control Strip. This relay closure provides a 15 VAC output to a local alarm light and removes AC power from an outlet to which a Model 4722 Alarm Carrier Generator is connected. The Alarm Carrier Generator normally transmitts a 108.625 MHz carrier through the CATV distribution system, except during the time of equipment failure, at which time its AC power is disconnected. In addition, the Alarm Control Strip provides a 1 form C contact closure which can be used to activate a telephone alarm dialer or auxiliary equipment.

The 108.625 MHz Alarm Carrier Generator's signal can be received at any point in the CATV distribution system at which a Model 4624 Alarm Carrier Receiver is installed. Typical locations for these receivers are in the CATV office or in the homes of maintenance personnel.

When the Alarm Carrier Generator is "on," the Alarm Carrier Receiver receives this signal and is silenced.

If headend equipment should fail and revert to backup equipment, or if an amplifier in the distribution between the Alarm Generator and the Alarm Receiver should fail, the Alarm Receiver will generate an audible and visual alarm to notify maintenance personnel immediately that a problem has occurred.

Viewing the TV signals at the Alarm Receiver location will quickly determine whether a distribution amplifier has failed, or the problem lies in the headend.

Aside from the automatic backup and alarm function, this improved reliability headend is designed to cut maintenance to a bare minimum, by using a common, easily replaced P.C. board for all headend amplifiers, the alarm carrier generator, alarm receivers, the pilot carrier, and the carrier substitution generators.

Figure #3 shows the same system using separate aural and visual MCA-BTV's and an Aural/Visual Carrier Separator.

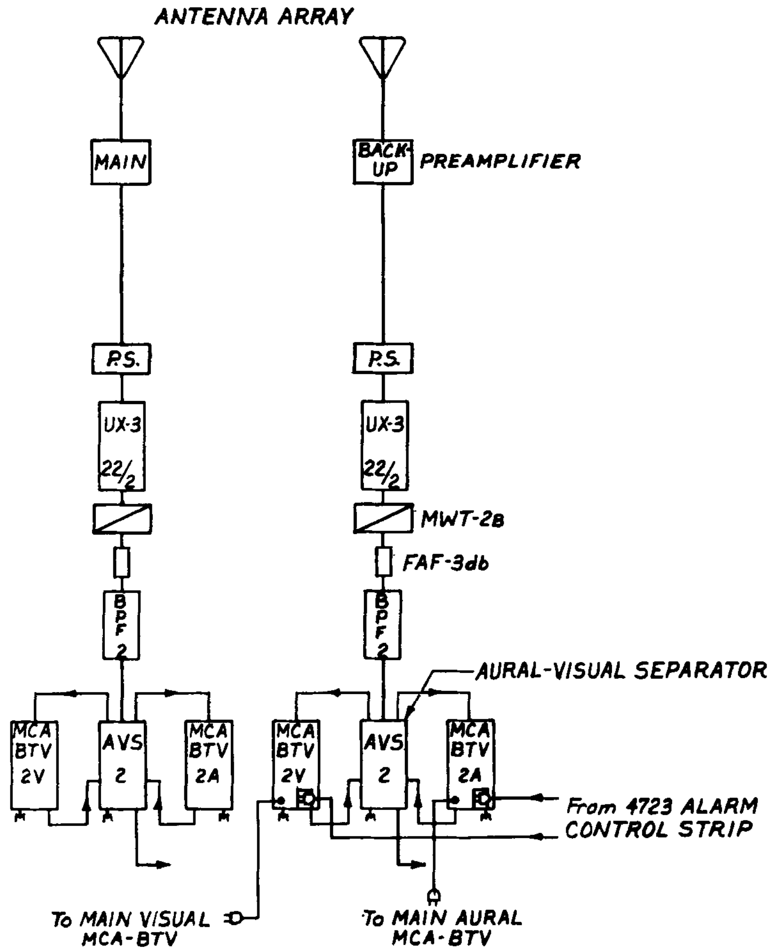


Figure #3

Other Alarm Capabilities

The features of the improved reliability headend also lend themselves to other types of alarms, such as temperature alarm, intrusion alarm, fire alarm, low AC line voltage alarm, etc., simply by plugging a low voltage controlled, 117 VAC relay (ALCO FRE-103) into the Alarm Control Strip.

Each relay takes up the place of one set of MCA-BTV amplifiers (Main and Backup.) The relay is plugged directly into a convenience outlet on the strip and the Alarm Control Strip sensing cable plugs directly into the relay.

As this relay can be connected for normally "on," or normally "off," it can be controlled by shorting or opening its low voltage output with thermostats, door switches, photoelectric cells, or AC line voltage meter relays.

The entire headend is further protected by the addition of a Model 4694 Overvoltage Protector (O.V.P.) in the AC line.

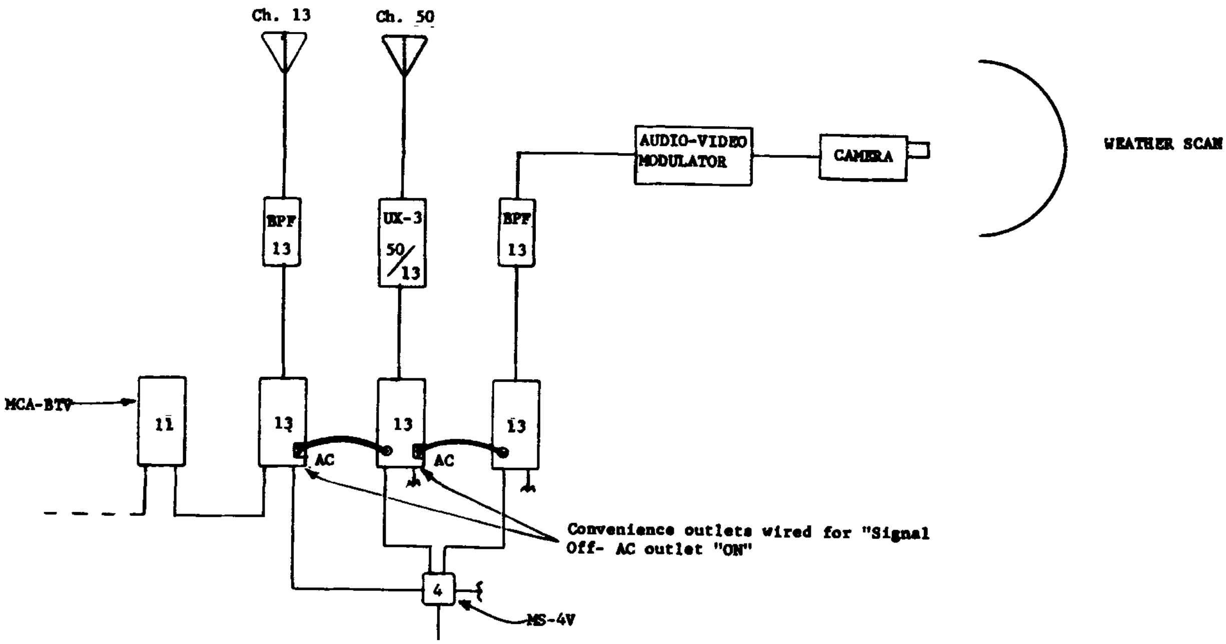
The O.V.P. protects the entire headend high voltage spikes, and more importantly, against AC line overvoltages, which can be deadly to solid-state equipment, even though the equipment is internally protected against short duration high voltage spikes.

The O.V.P. protects against the AC line voltage excesses which often accompany restoration of power following a power failure. The O.V.P. shuts off all AC power to the headend when its input voltage exceeds 135 VAC.

Having a channel amplifier which acts as an R.F. controlled relay, lends itself to many other uses, such as:

1. Channel substitution upon loss of the R.F. signal. This system can be applied to TV channels with erratic air times.

   Figure #4 shows the setup for such a system.



When channel 13 leaves the air, ch. 50 will replace it. If ch. 50 is not on the air, ch. 13 program will be provided by the weather scan.

The primary channel normally provides signal to the CATV system. If this primary MCA-BTV looses signal, it cuts off its R.F. output and switches AC power to its AC convenience outlet. The secondary MCA-BTV is then turned on and its programming replaces that of the primary MCA-BTV. If the secondary MCA-BTV "sees" no signal at its output, it will turn its output off and provide power to a third MCA-BTV which will provide a second alternate program.

Programming will again revert to the primary amplifier when that amplifier again receives signal.

2. Figure #5 shows an automatic backup of an existing headend. One MCA-BTV is used as a signal sensing relay and a second MCA-BTV is used as the backup channel processor.

3. Figure #6 shows a typical diversity reception using MCA-BTV's.

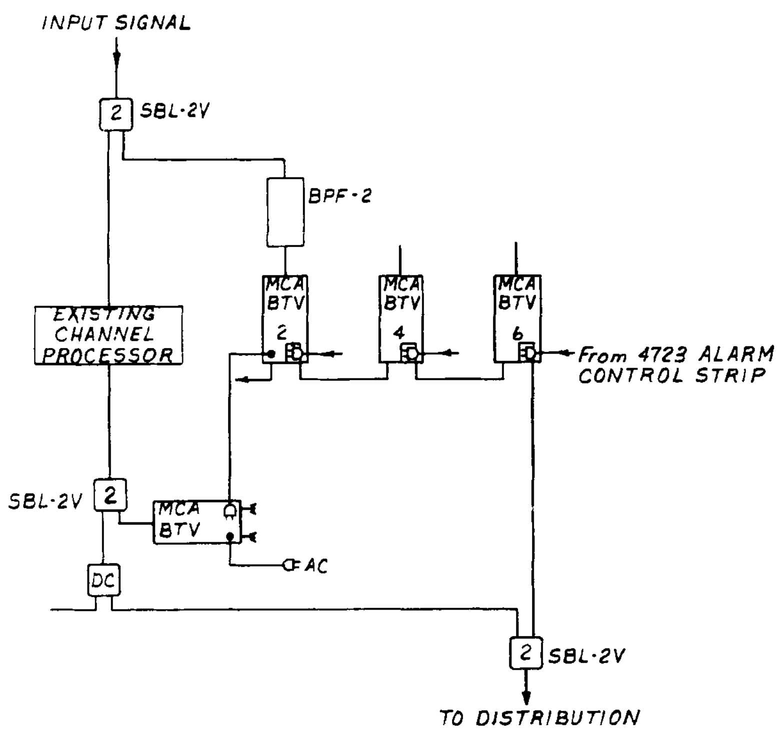


Figure #5

Automatic Backup Of An Existing Headend

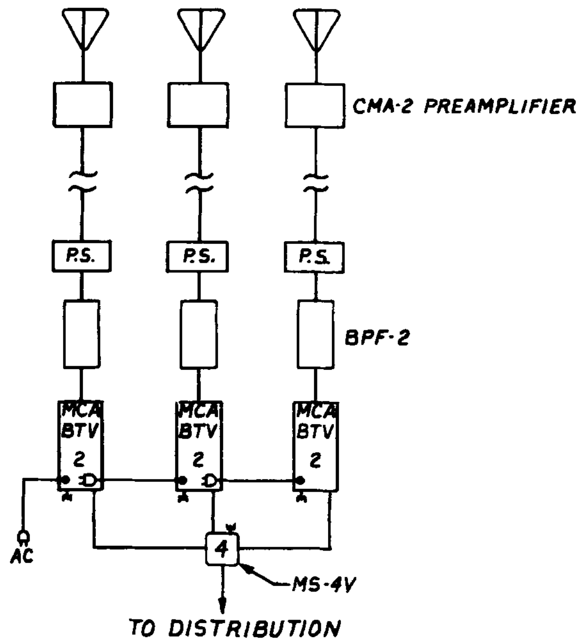


Figure #6

Typical Diversity Reception