ACTIVE TRAP TECHNOLOGY AND ADDRESSABILITY

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PICO Products, Inc.

ACTIVE TRAP

The concept of the Active Trap is an extension of the technology used for many years in the negative trap.

The Active Trap is a two pole, phase cancelling device with one pole fixed-tuned to the video carrier of the channel and the second pole tuned by voltage applied to a varactor diode. This square wave voltage causes the varactor-tuned pole to pass through the frequency to which the fixed pole is tuned. Each time this happens (47,118 times per second), maximum attenuation of the video carrier will occur. When the poles are not tuned to the same frequency, the video carrier attenuation will be at its minimum.

The difference in attenuation of the video carrier between the electronically tuned, then de-tuned condition of the active trap results in a 99.6% AM modulation of the video carrier with the 47KHz scramble signal. This scramble causes a permanent "overwrite" of the video intelligence and sync signal on the channel.

SECURITY RATIONALE

If it is technically possible for the manufacturer of a Pay TV security system to design a decoder for their scramble scheme, one can also be designed by the Pay TV pirate.

The Pay TV pirate has a great advantage. He can produce a decoder at a lower cost than the CATV security manufacturer because he does not need to provide for addressability and perfect signal recovery. In addition, he can sell his decoders at a price higher than the CATV operator pays for his legal decoders. This results in a fantastic profit margin for the Pay TV pirate.

Pico Products, Inc. considered these factors when they formulated a scramble system for which a decoder could not be designed; by them or the Pay TV pirate. The system was designed so the encoder is turned off to unscramble the signal. Since the signal is not decoded, it can be totally destroyed.

The Addressable electronics are placed outside - subscriber tampering in the home is eliminated.

Hence, the advent of the Pico OTAS System (Outdoor Terminal Addressable Security).

SUBSCRIBER TERMINAL

The Pico OTAS subscriber module is plugged into a high security housing that can be strand, pole or pedestal mounted. This housing utilizes state of the art light weight, nickel plated, structural foam molded plastic. The terminal serves 1 to 4 subscribers and is wired between the outputs of the existing multitap and the subscriber drops with coaxial cable. Multiple dwelling terminals are mounted in security cabinets capable of handling eight (8) subscribers (Figure 1).

Fig. 1 OTAS Subscriber Terminal

Each terminal has the ability to control seven (7) premium tiers plus basic on/off service per subscriber.

Unlike other scramble methods, the action of scrambling the seven tiers literally destroys the TV signal. The signal can not be recovered by reversing the encoding process.

The scramble is accomplished with small Active Traps (patent pending) used to scramble each of the seven tiers (Figure 2). Each Active Trap is a two pole, phase cancelling trap. One pole is tuned to the visual carrier of the channel. The second pole is tuned by a voltage applied to a varactor diode. This square wave voltage causes the varactor-tuned pole to pass through the frequency to which the fixed pole is tuned. Each time this happens, (47,118 times per second, slightly less than 3 times horizontal frequency), the Active Trap will attenuate the picture carrier by 70dB (Figure 3).

When the poles are not tuned to the same frequency, the pix carrier is attenuated by 22dB.

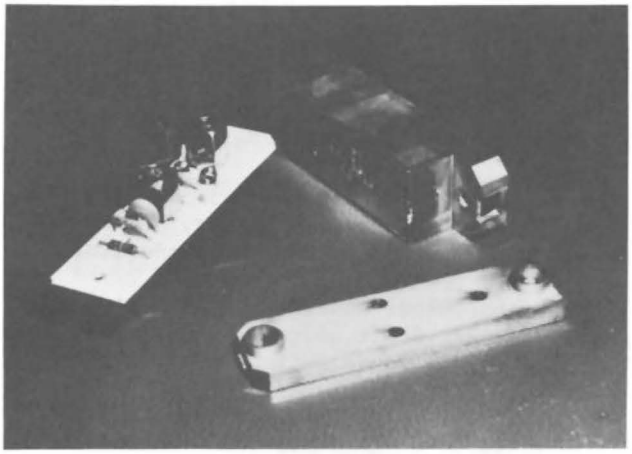

Fig. 2 Active Trap

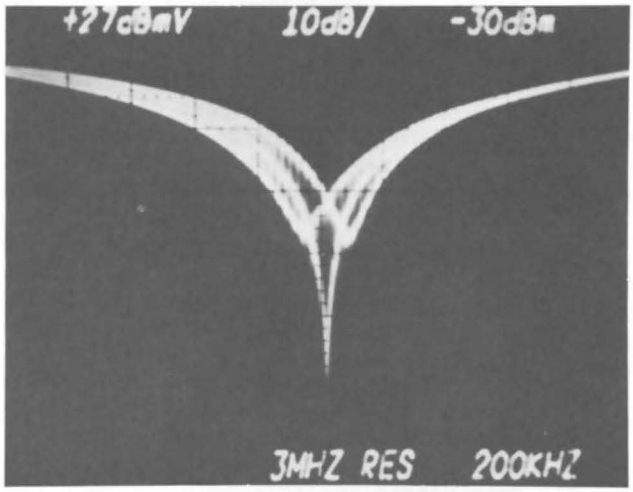

Fig. 3 Swept response of Active Trap on Spectrum Analyzer

The 48dB difference in pix carrier level between the electronically tuned, then de-tuned condition of the Active Trap results in a 99.6 percent AM modulation of the pix carrier with the 47KHz scramble signal. Interfering carrier and sync suppression scramble methods depend on the TV set to cause the scrambled picture. The OTAS scramble causes a permanent "overwrite" of the video intelligence and sync signal of the channel. Once part of the video modulation, the scramble can never be removed.

In addition to the amplitude modulation of the pix carrier, the Active Trap also phase modulates the pix carrier with 47KHz. This modulation is caused by the rapid phase changes that the Active Trap undergoes when it is tuning and de-tuning. After intercarrier detection, the TV set "sees" this phase modulation as FM modulation of the aural intercarrier signal. The 47KHz audio is above audible range and cannot be heard, so the 47KHz tone is "broken up" with a 47 KHz frequency divided by 32, 64, and 4096; tones that can be heard in the TV audio output causing an aural scramble.

The voltage that is applied to the varactor is generated by a scramble generator within the 4-subscriber addressable terminal. This 47KHz frequency is held constant through-out the CATV system by genlocking the scramble generator oscillator at each subscriber terminal to a multiple of the central computer data rate (Figures 4 & 5).

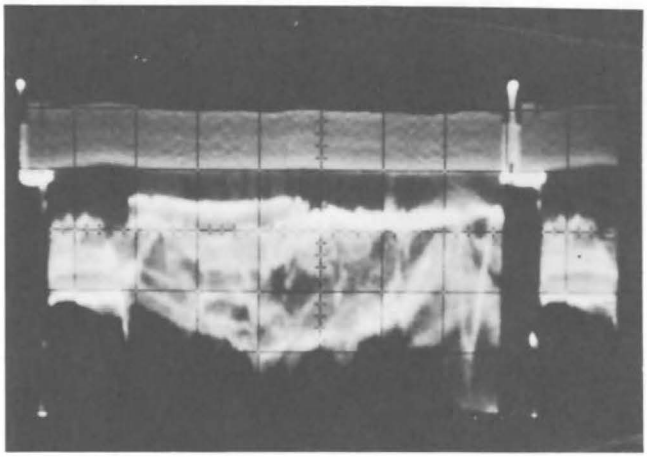

Fig. 4 Oscilloscope photo of unscrambled video

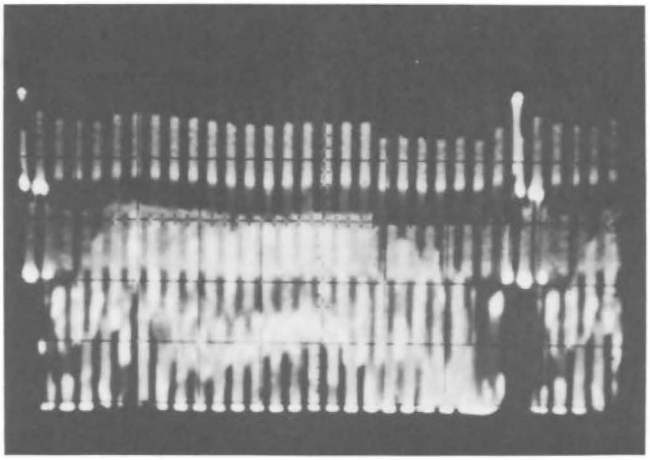

Fig. 5 Oscilloscope photo of Active Trap scrambled video

If a subscriber wants to receive a premium channel service, an order must be entered into the computer terminal. A command is then sent to the subscriber terminal to bypass the Active Trap associated with the requested premium channel. The bypass of the Active Trap is accomplished electronically with two (2) SPDT pin diode switches (Figures 6 & 7).

Subscriber terminals are addressed with a digital data stream that consists of a combination of binary and trinary bits modulated on 103.7 MHz FSK carrier. Each subscriber terminal must receive its correct address and the same command twice in succession before it will execute the command. This Double Valid Data requirement essentially eliminates data decoder errors. For example, a system that might have one error per day using the standard single valid data transmission scheme would have one error per 12,092 years using the Double Valid Data scheme.

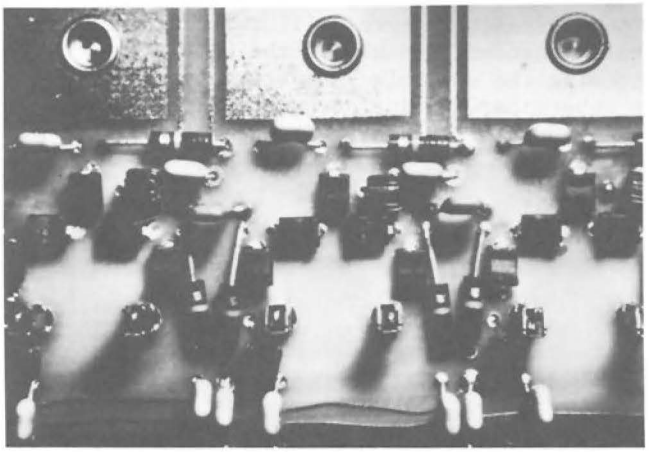

Fig. 6 Pin Diode switch on subscriber module pc board

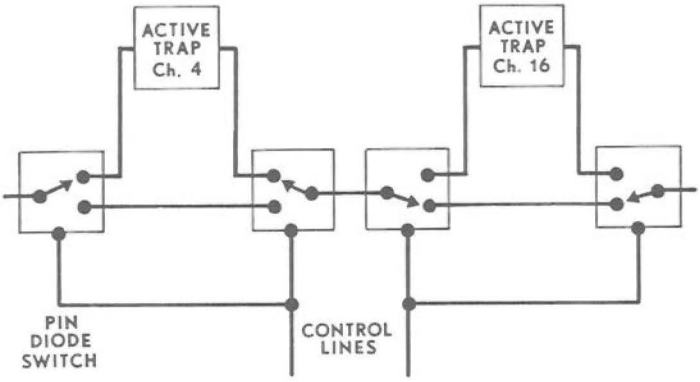

Fig. 7 Block diagram of bypass of Active Trap

The subscriber terminal electronics consists of a security housing and up to four (4) plug-in subscriber modules (Figure 8). The terminal is powered through the subscriber coaxial drop from pocket calculator size, low voltage power supplies on the subscriber premises. A four subscriber terminal is capable of being powered from a single power supply in the event that all other subscribers on the housing unplug their power supplies or have disconnected service.

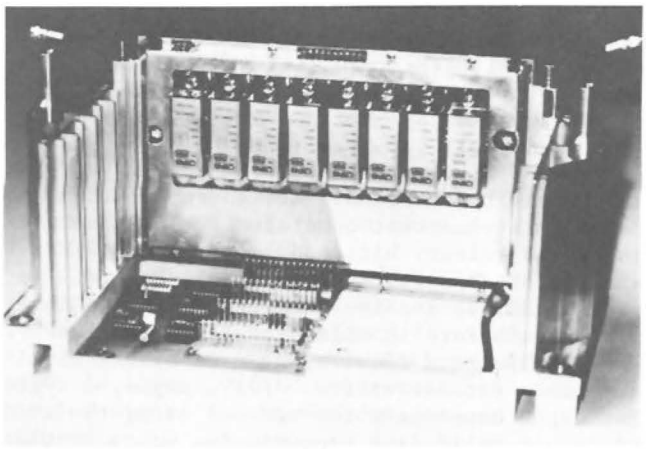

Fig. 8 Subscriber Module and Housing Modules removed from weather housing

To prevent subscribers from purposely or accidentally disconnecting their power supplies, circuitry has been provided to sense power on the subscriber drop cable and to interrupt the Basic Service latch if power is removed. Thus, if subscribers unplug their power supplies, they receive no TV signal at all. The TV signal is instantly restored when the power supply is reconnected.

The security housing contains an RF modulator-demodulator, 9 bit address decoder, 9 bit global command decoder, and the scramble generator.

Each subscriber module contains an address/command decoder, 8 bit addressable latch, 9 bit data encoder, pin diode switch driver, and eight pin diode switches.

Security housings receive a computer generated address in manufacturing. The computer blows fuses on a plug-in module and prints the housing serial number which is the same number as address. The subscriber module is not given an address in manufacturing, but receives its address upon being plugged into the housing module. This allows complete interchangeability without changing address. No knowledge of binary or trinary addressing is required by installers in the field. This prevents incorrect and/or duplicate addresses.

The OTAS subscriber terminals allow for a maximum of 314,415 subscriber addresses per system, although the standard headend Data Controllers available at this time handle up to 100,000 subscribers. The number of subscribers capable of being handled depends only upon the number of MOS Random Access Memory (RAM) IC's added to the Data Controller and the capacity of the Winchester hard disc memory used

The Data Controller addresses the subscriber terminals at the rate of 10,000 to 16,000 subscribers per minute for per view Pay TV, (a single global command turns on all pay-per-view customers on or off at once), and at a rate of 2500 subscribers per minute for continuously re-addressing subscriber terminal with service level latch commands. In a two-way CATV system, an audit program can be used which increases the number of subscribers from 2,500 to 16,000. This is possible because the subscriber terminal is only interrogated as to the status of its service latches. This data is returned to the central computer location on a crystal controlled 24.3 MHz FSK carrier. If there is a discrepancy between the service level the customer actually has and the service level indicated by the data controller, the proper service level commands are sent to that subscriber.

The Audit is also useful in locating failures in the cable plant. Subscribers failing to reply can be listed by address on the computer CRT. In one-way cable systems, the reply portion of the computer program can be disabled.

Diplexers pass 5-35 MHz around the subscriber terminal to the subscriber drop. This path is normally disconnected to prevent return path ingress from entering the CATV plant from the subscriber's premises (the greatest cause of

ingress). By installing a plug-in jumper cable, customers may subscribe to a return path service not associated with the OTAS system. These jumpers can be installed without removing the Subscriber Modules from the housing.

CENTRAL COMPUTER SYSTEM

The central computer system consists of six basic parts:

1. Pico Data Controller (Figure 9)
2. Pico Communications Controller
3. IBM PC File System and hard disk Controller
4. Winchester/hard disk memory
5. Up to eight IBM PC Work Stations
6. Printer(s)

All computer equipment required for the OTAS system is off-the-shelf and unmodified, qualifying it for manufacturer's service contracts.

The Pico Data Controller is an entirely self-contained subscriber controller that operates independently of other computer equipment. The Data Controller is designed for a higher MTBF than the rest of the computer system. It uses MOS memory and an uninterruptable power supply (UPS). Its function is to continuously address the subscriber terminals with data that has been stored in its memory by the File System or the Work Station. Because the Data Controller contains a real time clock and is able to store pay-per-view turn-on information for execution at a future date, the disastrous results of a computer power failure are avoided. This works even if the Data Controller is disconnected from the rest of the equipment. In addition, it contains elaborate self-test programs that can provide automatic switch over to a backup Data Controller in case of malfunction. In the event of a failure of the Data Controller, the subscriber terminals will maintain their service levels indefinitely.

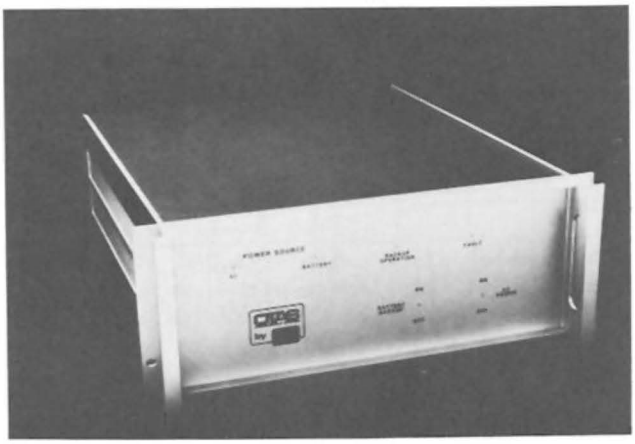

Fig. 9 Pico Data Controller

Incorporated in the Data Controller is a programmable protocal EPROM. The EPROM simplifies the downloading process from the central computer and custom software to the Data Controller itself. The downloading can be accomplished by telephone lines or satellite down link.

OTAS uses IBM Personal Computers in its system. These are used as intelligent terminals and also serve as the work stations of the system. Up to eight of these computers may be connected to the Communications Controller which is essentially the "traffic cop" of the system. The programs are on a mini disc which is loaded into the computer with a self contained mini disc drive.

The terminal operator can retrieve data from File System and change any data in the File System that he or she is authorized by password to change (eg. customer service level commands, per view turn on, billing date start, etc.). When the terminal operator has finished entries, the data is loaded into File System along with date/time, and the name of the operator making the entry. The data is then entered into the Data Controller.

The IBM PC Work Stations can also be used in the local mode with any of IBM's programs for this computer. Programs include: word processor, accounts payable, general ledger, payroll, income tax, etc. Programs can also be written on this computer that use the CATV subscriber data base stored on the File System hard disc, but the data base cannot be changed either purposely or accidentally.

FILE SYSTEM

The File System and Hard Disc are the storage areas for all subscriber statistics and contain numerous programs such as customer statistics, per view program guide, billing mailing labels, printer control, Data Controller control, trouble reporting, self monitoring, maintenance programs, etc.

The Work Stations, Hard Disc, and the File System may be turned off when not in use and the subscriber addressing will continue from the Data Controller. This greatly increases the MTBF of this equipment.