Security Alert
A Two-way Digital Communications System

Marvin Roth, Senior Engineer
Scientific-Atlanta, Inc.
Commerical Communication Div.

INTRODUCTION

For years CATV has provided a one-way communications system. Many people have proposed an increase in the services offered to the subscriber by providing two-way communications utilizing the CATV distribution system. The uses and applications of such systems are limited only by one's imagination. The technical problems of two-way data communications system have been solved; hardware has been developed and is now available. Scientific-Atlanta's Security-Alert system is such a system.

The Security-Alert two-way data communications system was developed primarily for use in monitoring and reporting the condition of many remotely located transponder units (subscriber stations) to a centrally located interrogation unit (central station). The information to be communicated is digitally encoded and modulated on an FSK (Frequency Shift Keyed) carrier and transmitted over the CATV cable distribution system.

The system consists of a central station (to be located at the headend or some central distribution point), the transmission path, (the CATV distribution system), and the subscriber stations (one unit for each subscriber).

A few of the many applications include the monitoring and status reporting of:

1. Home fire and intrusion alarms
2. Monitoring on-off conditions of remotely located equipment
3. Telemetering equipment to measure parameters such as voltage, current, power levels, temperature, pressure,etc.
4. Monitoring and reporting locations of faults along the CATV distribution line

The system can be easily modified to provide the capability for additional applications such as:

1. TV tuner monitoring and polling
2. Opinion polling
3. Mass audience participation game-playing
4. Remote control of equipment and machinery

SYSTEM DESCRIPTION

Security-Alert is an automatic sequential polling system. (Figure 1) Five bits of binary coded information (32 different messages or alarms) can be received by the central station from each of 8,192 subscriber stations. The output of the system is a printed record showing any change of status of alarm (message) from the subscriber stations. Refer to Figure 2. The information which is recorded by the digital printer contains:

1. A five digit OCTAL coded address
2. A two digit OCTAL coded alarm (message)
3. The time of day when the alarm (message) was received

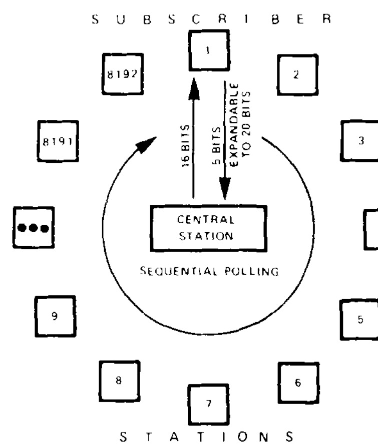

Figure 1 Sequential Polling

ADDRESS CODE	ALARM CODE	TIME HR/MIN
11657	04	1156
10615	07	1021
01253	25	0907

1ST Alarm occurred at 9:07 A.M.
Subscriber 01253 reported a Code 25.

2ND Alarm occurred at 10:21 A.M.
Subscriber 10615 reported a Code 07.

3RD Alarm occurred at 11:56 A.M.
Subscriber 11657 reported a Code 04.

Code 40 = Power Failure
Code 41 = Data Failure
Code 42 = False Alarm

All other Codes are assigned by the user.

Figure 2 Recorded Output

Fail safe provisions have been incorporated within the system. If a subscriber station is polled and an answer is not received within a reasonable time period, the system interprets the nonresponse and a "power failure" code is printed out for that subscriber station's address. A positive response must be received, or a power failure printout occurs. This feature can be used to easily locate equipment failures along the CATV distribution line as well as locating faulty subscriber units. Two other fault location indicating codes are also automatically interpreted and printed out when they occur.

The speed of transmission and processing information is of utmost importance in communications systems carrying information which may mean the difference between life and death, such as reporting fires. Security-Alert was designed with this thought in mind. The system cycle time (the time it takes to sequentially poll, examine, and report the response of 8,192 subscribers) is variable. The system is an adaptive one. For a fixed bit rate, and a time division multiplex system the cycle time depends on:

1. The total number of active subscriber stations.
2. The distance of each subscriber station to the central station
3. The number of alarm/messages and change of status of alarm/messages.

For example, let us consider the case of 8,192 subscriber units whose average distance from the central station is ten miles (20 miles round trip). If no alarms exist, the cycle time would be approximately five seconds. For each change of status of alarm/message, the cycle time would be increased by 0.5 seconds (the time it takes to print out the message).

Means have been provided in the basic system to easily change the system capacity. Two bits (four unique combinations) are not used in the basic system but are available in the interrogation word. These two bits can be used to:

1. Increase the maximum number of subscriber units sending five bits of alarm/message information from 8,192 to 32,768.
2. Increase the number of alarm message bits received from 8,192 subscriber units from 5 bits to 20 bits (1,048,576 different combinations).
3. Combinations of the two extremes of the above.
4. The two extra bits can also be used as command or instruction words to cause an event to occur at any subscriber station (such as remotely turning equipment off or on).

BASIC OPERATION

The Security-Alert system operates on a master-slave principle. The master unit is the central station. All of the subscriber stations are slave units. Each subscriber station is assigned and programmed to recognize a unique binary coded address word. A subscriber unit is capable of transmitting information only after it has decoded the input address code, compared it with the preprogrammed address and recognized it as its own address. Refer to Figure 3.

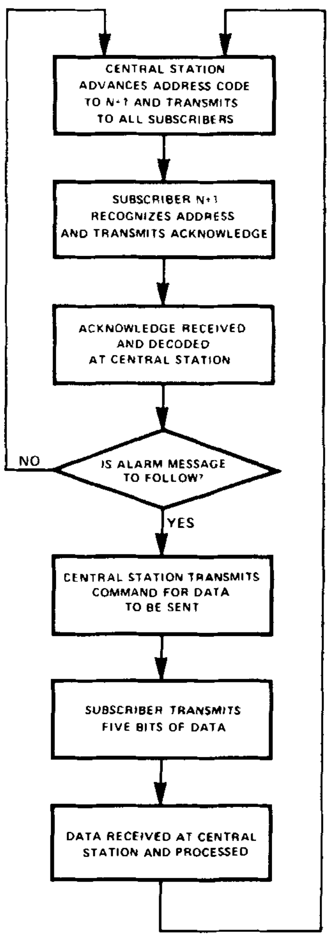

Figure 3
Flow Diagram of Basic Operation

The address code is transmitted by the central station to all subscriber stations. The subscriber station which is pre-programmed to recognize that unique address replies with an acknowledgement pulse. This acknowledgement pulse is coded to indicate whether an alarm message exists or not. If there is no alarm message the central station advances the address by one count and transmits the new address to all subscriber stations. If an alarm message is received the central station transmits a command causing the answering subscriber station to transmit a five bit binary word which contains the alarm message. This two-step method of alarm reception was chosen to decrease system cycle time. If no alarms are reported, only one bit is transmitted in the reverse direction. Five bits are transmitted only when an alarm condition exists. After the central station processes the alarm message the address word is advanced one count and the next subscriber station is interrogated.

CENTRAL STATION

The central station produces all timing and control signals used by the system. The timing signals are transmitted along with data to all subscriber units. The transmission of these timing signals eliminates the need for timing oscillators and complicated circuits to phase lock the incoming data in each subscriber station.

The central station is comprised of four major subsystems (refer to Figure 4). A digital clock provides a visual display of hours, minutes, and seconds. It also provides the proper signals representing hours and minutes for recording on the digital printer.

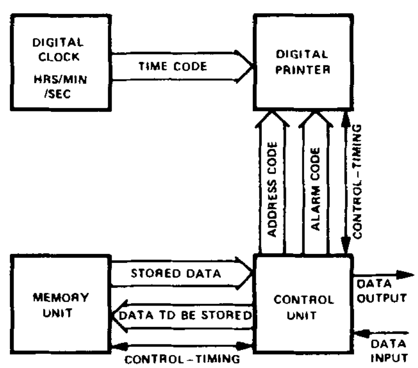

Figure 4
Central Station Block Diagram

The digital printer is the primary output device. As previously discussed, it prints the alarm code, the address code, and the time of day automatically upon command from the control unit.

The control unit provides all timing and control signals, transmits an interrogation word to all subscriber units, receives the subscriber station's reply, processes the information and causes an output when required.

The memory unit provides eight bits of storage for each of the 8,192 addresses. Addresses can be manually assigned in memory. If an address is assigned it is transmitted. If the address is not assigned, the control unit does not transmit that address code. The address register is advanced and the next address is processed. The memory is nonvolatile and remembers the last alarm printed for all addresses. The data in memory is compared with the input data and a printout occurs only when the incoming alarm for a particular address is different from that previously recorded and memorized. The system senses and prints a change of status of alarm rather than an alarm. It is obvious that this increases system speed by preventing the same information from being printed more than once.

Since the central station controls the entire system, let us start with the generation of an interrogation word and follow the signal as it travels to and from the subscriber station.

INTERROGATION WORD

The "interrogation word" is a polling command which is simultaneously transmitted to all subscriber stations. It contains data composed of 16 bits of binary coded information as well as timing signals. The data portion of the interrogation word is produced by generating a 13 bit binary code address word and applying these in parallel with three other bits to a parallel-to-serial converter. The output of the parallel-to-serial converter is a 16 bit NRZ (Non Return to Zero)word. Refer to Figure 5.

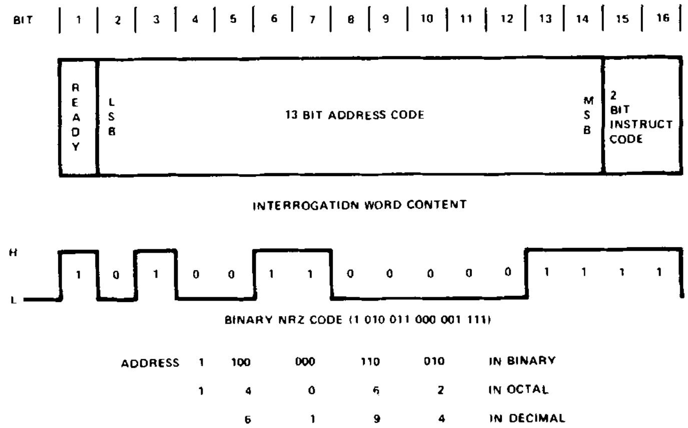

Figure 5 Interrogation Word

The first bit is used to ready all subscriber units by resetting a counter in each unit. The next thirteen bits contain the address code. The last two bits are reserved and can be used to issue instruction commands, to increase the maximum number of subscribers, or to increase the number of alarm/message bits from the subscriber.

The binary coded NRZ word has timing signals added to it by a bi-phase encoder. The output of the bi-phase encoder is then modulated and transmitted.

Figure 6 shows a binary NRZ code.

each clock pulse transistion. Data and timing information are combined and transmitted on one continous pulse train.

The clock rate of both Ø 1 and Ø 2 is 160 KHz. The data is derived from Ø 2 producing a bit rate of 160,000 bits/second. Since the interrogating word contains sixteen bits, the length of the interrogation word is 100 microseconds. Since the bi-phase code consists of the interlacing both Ø 1 and Ø 2, the maximum transmission modulation rate is 320 KHz.

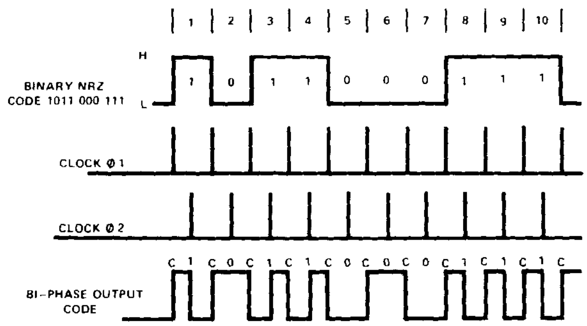

Figure 6 Bi-Phase Encoder Timing Diagram

Ten bits are shown for simplicity. A binary "one" is represented by a high level, and a binary "zero" is represented by a low level. Timing information such as the data rate is not contained in this code. To identify the binary code it is necessary to know the data rate so the word can be examined and the code understood. By adding timing signals to the binary NRZ code through an encoder as shown in Figure 7, a bi-phase code is generated.

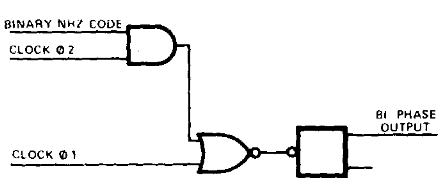

Figure 7 Bi-Phase Encoder

By examing the bi-phase code shown in Figure 6, it can be seen that the levels of "high" and "low" are meaningless and that data and timing information is contained in the transistion between the high and low levels. For each clock pulse Ø 1 a transistion occurs. When the input data is high a transistion occurs at a clock pulse Ø 2 and when the input data is "low" a transistion does not occur. The clock pulses occur at a regular interval, the clock period. The data always occurs half way between

FORWARD TRANSMISSION PATH

The bi-phase binary encoded interrogation word modulates an FSK (Frequency Shift Keyed) transmitter. Refer to Figure 8. A binary "one" is transmitted at a frequency of 113.9 MHz and a binary "zero" is transmitted at a frequency of 111.1 MHz. The two frequencies are generated by precision crystal controlled oscillators.

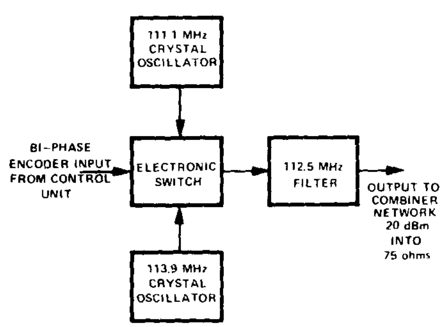

Figure 8
112.5 MHz Transmitter Block Diagram

The output of the oscillators are passed through bandpass filters with very steep slopes to keep unwanted sidebands out of other channels. Available power at the 75 ohm output terminals is +29 dBmV. This will be at least 15dB below the normal level of TV signals at the combiner output. The modulated interrogation word is added with the TV signal in a combiner network and travels down the normal CATV distribution system to each subscriber unit. The input range of the receiver in the subscriber set can vary in signal strength from -10 dBmV to +15 dBmV and still be within its operational range.

Propagation delay along the distribution system is an important parameter in calculating system cycle time (refer to Table 1). It consists of cable delay and delays through the various amplifiers and various amplifiers and passive devices along the distribution line. As a rule of thumb, a delay of 8.3 microseconds per mile is used when calculating system cycle times.

Table 1

FORWARD PATH PROPAGATION DELAY FOR INTERROGATION WORD	
INTERROGATION WORD LENGTH	100 MICRO SEC
FIXED TRANSMITTER-RECEIVER-DECODER DELAY	30 MICRO SEC
CABLE DELAY (INCLUDING 4 AMPLIFIERS/MILE)	8.3 MICRO SEC/MILE

SUBSCRIBER STATION

Refer to Figures 9 and 10.

The subscriber drop is always a single cable carrying two-way information, It enters the subscriber station unit where the input signal is split. Half of the signal is made available through a type "F" connector to provide signals to a TV set or other device. The digitally modulated signal passes through a passive frequency selective "tee" network and then into a 112.5 MHz receiver. The input sensitivity of the receiver is between -10 dBmV and +15 dBmV. The receiver consists of three stages of tuned amplification followed by a broadband limiter. The output of the limiter is fed to a discriminator circuit and the output level of the discriminator is sensed by a level detector which reproduces the transmitted bi-phase binary encoded word. The digital signal is then fed to a decoder and the timing signals are separated from the data contained in the bi-phase coded input word.

The first bit (always transmitted as a one) resets all counters and readies the transponder for more data. If a noise pulse were to provide this bit all subscriber stations would be inactive but ready, and would still interpret the first bit of the transmitted message as a ready pulse and not as data. Only a burst of noise having the same word length as the interrogation word would be interpreted as a transmission.

The timing pulses are counted in a binary counter located in the address comparator. The preprogrammed address is gated out and compared bit by bit with the input

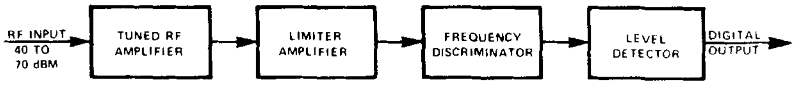

Figure 9 112.5 MHz Receiver

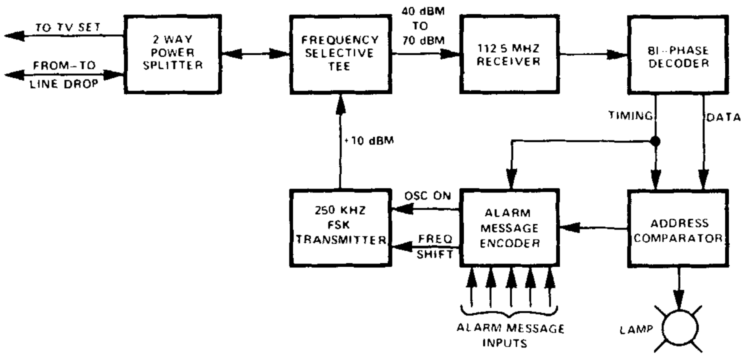

Figure 10 Block Diagram Subscriber Station

data. As soon as a subscriber station recognizes one bit difference between the input data and the preprogrammed address, it resets itself and waits for the next interrogation word. The one station which recognizes all input bits as being identical with its own preprogrammed address sets a bistable circuit. This causes two events to happen. A lamp on the front panel of the subscriber unit turns on signifying that this particular subscriber station is being interrogated. This provides a self-checking feature at the subscriber station.

At the same time the station's alarm message inputs are examined. If no alarm conditions exist (signified by open circuits to the five alarm message inputs) the 250 KHz FSK transmitter is instructed to turn on and transmit a 275 KHz signal for approximately 125 microseconds. If an alarm message exists (closure of one or more alarm message inputs) the transmitter is turned on and a frequency of 225 KHz is transmitted for approximately 125 microseconds. The signal is referred to as the acknowledge word and it is transmitted into the subscriber drop cable through the frequency selective tee network and power coupler.

The central station interprets the reception of 275 KHz as a no-alarm message and proceeds to advance the address register and interrogate the next subscriber station (see Figure 11). If the received signal is 225 KHz, then five 12.5 microsecond data strobe pulses spaced every 100 microseconds are transmitted sequentially to all subscriber stations. Only that subscriber station whose address had just been recognized allows the data strobes to be gated through to the alarm message encoder. The encoder converts the five input message code to a serial binary string of "ones" and "zeros." The 250 KHz FSK transmitter is turned on for a period of approximately 525 microseconds, and the transmission is FSK modulated between 225 KHz and 275 KHz by the data contained in the serially coded alarm message. The central station processes this information and then interrogates the next subscriber unit.

If two units in a time division multiplex system which uses one cable attempt to transmit at the same time and at the same frequency they will interfere with each other. A failure in one of the subscriber stations which would cause the transmitter to be turned on continously would render such a system useless. To prevent this, a simple fail safe feature has been incorporated in the 250 KHz transmitter. In the event of a failure of this type, the oscillator stage will turn itself off and remain off until the failure condition is corrected.

When this station is interrogated by the central station a "power failure" code will be printed out at the central station and the problem will be brought to the attention of the system operator.

Signals are available within the transponder to decode the two instruction word bits. These are used for optional features of the system.

REVERSE TRANSMISSION PATH

The acknowledgement pulse and the alarm message word are FSK modulated and transmitted in the reverse direction. A binary "one" is transmitted at a frequency of 275 KHz and a binary "zero" is transmitted at a frequency of 225 KHz. The power available at the transmitter output is +60 dBmV into a 75 ohm load. The input range at the receiver end is between +10 dBmV and +30 dBmV.

The system was designed for use with either a single cable or with a separate reverse transmission cable. The single cable system will require all components in the distribution system to be bi-directional. In an existing distribution system it may be desirable to install a separate low cost reverse transmission cable (RG59) instead of replacing all un-directional components. The loss along the cable (RG59) at the frequency of 0.25 MHz is approximately 20 dB per mile. To keep the signal level along the line above the minimum detectable level at the receiver, inexpensive low frequency amplifiers and combining networks are available. Since the loss per mile is low, fewer amplifiers would be required in the reverse than in the forward direction.

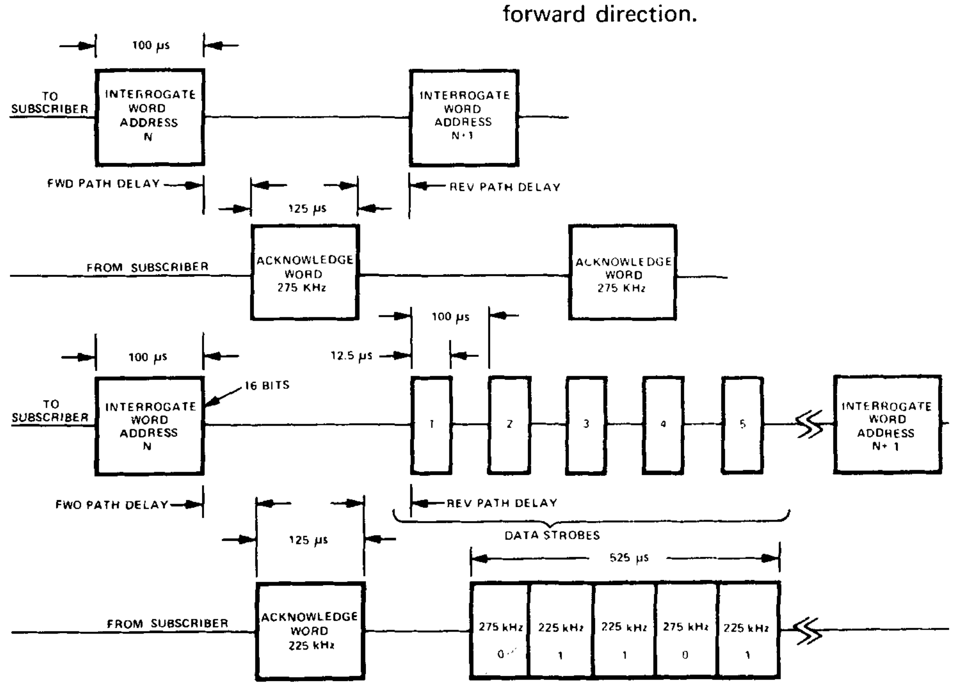

Figure 11 System Timing Diagram

The cable drop to the subscriber is always a single cable independent of the single or dual cable system.

In calculating the cycle time the forward transmission path propagation delay due to the cable and the components in the reverse transmission path must be taken into account. These are given in Table 2.

Table 2

REVERSE PATH PROPAGATION DELAY FOR ACKNOWLEDGEMENT WORD	
INTERROGATION WORD LENGTH	125 MICRO SEC
FIXED TRANSMITTER RECEIVER PROCESSOR DELAY	120 MICRO SEC
CABLE DELAY (INCLUDING 4 AMPLIFIERS/MILE)	8.3 MICRO SEC/MILE

DATA RECEPTION AND PROCESSING

The modulated acknowledgement pulse and alarm message which are transmitted in the reverse direction are received at the central station and applied to a 250 KHz, three-section Butterworth filter (see Figure 12). The filter outputs to a 250 KHz receiver which is composed of a limiter amplifier, a frequency discriminator, a level detector,

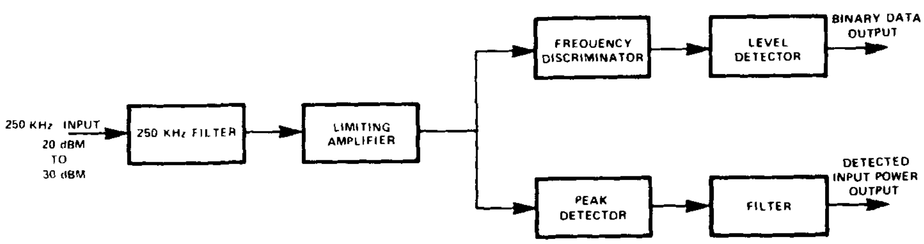

Figure 12 250 KHz Receiver & Filter

and a carrier presence detector. The input to the discriminator circuit and carrier presence detector is held constant by the limiter amplifier as the input signal level varies from 3 millivolts to 30 millivolts. The carrier presence detector provides an output (a binary "one") whenever a signal (either 225 KHz or 275 KHz) is received. The frequency discriminator and level detector provide a binary "one" only when the input signal frequency is 225 KHz. The two digital outputs are applied to the data processing portion of the control station.

Figure 13 shows a block diagram of the control unit. The control unit is normally automatic in operation; however, an operator may take control of the system manually. All timing signals are derived from a 1.28 MHz crystal controlled master clock oscillator. The output of the oscillator is divided down to provide the required timing signals. All signals (input, printer, manual commands) which are asychronous in nature are synchronized with the master clock before being processed. This may delay data processing up to one clock period, but the delay is small compared with other system delays.

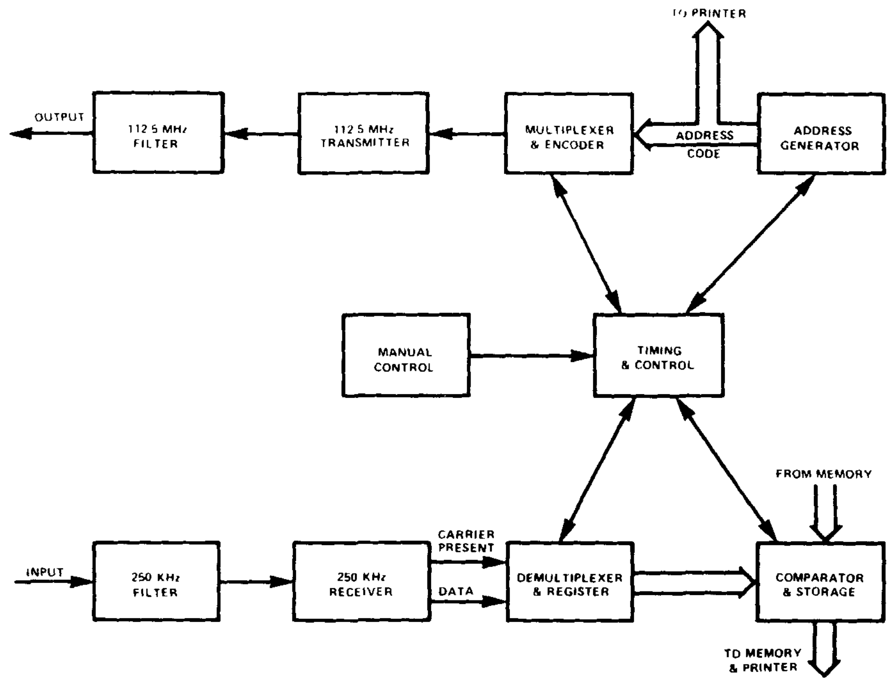

Figure 13 Control Unit Block Diagram

ADDRESS GENERATOR AND MULTIPLEXER

A block diagram of the address generator and multiplexer is shown in Figure 14. The 160 KHz clock Ø 2 is applied to a 13 bit binary counter through NAND gate 1. The second input to NAND gate1 consists of inhibit functions derived in the timing and control circuitry. When data is being processed the address counter is prevented from being advanced. The address counter will advance only when both inputs to NAND gate 1 are high. Right after the advance of the address counter, the timing and control circuitry cause an inhibit function to occur until the data received from the new address is processed.

The timing and control circuits also provide inhibit functions to NAND gate 2. This gate sets a bistable circuit which allows the 160 KHz clock (Ø 2) pulses to be applied to a four-bit binary counter. The 16th count of the counter is detected and bistable circuit 1 is reset, and remains reset until the next uninhibited clock pulse is allowed to set it. The four output lines of the counter are applied, to and control the single output line of a 16 line to 1 line multiplexer. The 16 lines of input consist of the 13 bit address code and three other bits entered in parrallel. The bits are sequentially gated out of the multiplexer on the output line a bit at a time, as controlled by the 16

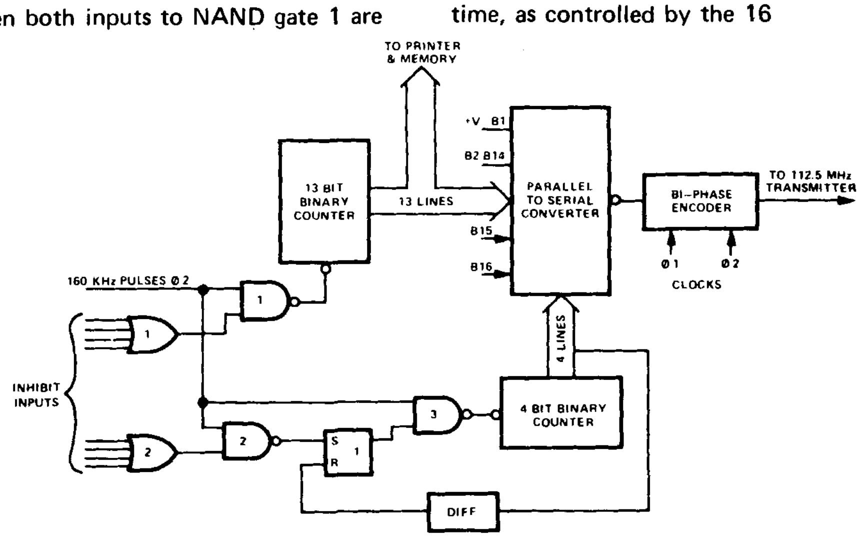

Figure 14 Address Generator & Multiplexer

combinations of the four bit control line. The sequential single line output is applied to the bi-phase encoder and then to the 112.5 MHz transmitter.

DEMULTIPLEXER AND DATA REGISTER

The 250 KHz receiver provides two output signals. One output signal occurs when a carrier signal of either input frequency is present. The second output signal is the detected data (refer to Figure 15). At the end of the transmission of an interrogation word, a pulse is generated by the timing and control circuitry that sets a bistable circuit starting a clamped time delay circuit. The time delay is set for the maximum round trip propagation delay time of the system. If a signal is received before the end of this period then the bistable circuit is reset and the input data is examined by NAND gates 1 and 2. A binary "one" is decoded by gate 1 as a "no alarm" message. A binary "zero" is decoded by gate 2 as an alarm message. The output of NAND gate 3 causes code 40 to be recorded and stored in memory if a signal is not received before the end of the time delay period, and if Code 40 (power failure) has not been previously printed for this address.

If the data received contains a "no alarm" message it is compared with data stored in memory. If a "no alarm" message was not previously stored in memory code "00" is printed out. If the received data was decoded as an alarm message then the data strobe generator is actuated and five sequential data strobes are transmitted to the answering subscriber station. The subscriber station will reply with a five bit binary coded message. When this signal is received the data trigger generator is actuated and five sequential triggers are generated. The triggers are used to sequentially gate the serial input data into a serial-to-parallel converter. Since the timing of the triggers is based on the reception of the data word, each bit will be read in and stored at the proper time. At the end of the fifth trigger a "cycle count trigger" is generated. The output of the serial-to-parallel converter (the data register) will hold the stored five bit input data word until the next data word is received by the system.

ALARM COMPARATOR (Figure 16)

When an alarm is detected the message is examined three times to prevent the processing of a possible false alarm. The five bits of input data are compared with the message previously stored in memory for the address being interrogated. If the output of Comparator 1 is a binary zero (an equal condition) at the time the "cycle count trigger" occurs, the timing and control circuitry cause the address generator to advance, and the next address is interrogated. If the output of Comparator 1 is a binary one, it is gated with the "cycle count trigger" in NAND gate 1 and bistable 1 is set. This causes one input of NAND gate 2 to go high and also causes the five bit input data word to be stored and held in a five bit "latch" circuit. The timing and control circuitry then cause the same address to be interrogated for a second time. The second set of five bits of input data is compared in comparator 2 with the first set of data previously placed in storage. If the two sets of data are not equal bistable two is placed in the set state. The same address is interrogated for a third time at the end of the "cycle count trigger". The third set of input data is compared with the stored first set in comparator 2. Bistable 2 is set if the comparison indicates a "not equal" condition.

Each time the cycle count trigger occurs, a modulus 3 counter is advanced one count. After the third trigger the two gates NAND 3 and NAND 4 are strobed. If the input data was identical three consecutive times then gate 4 causes a "print alarm" command to occur. The five bit coded message stored in those data registers is printed by the recorder and stored in memory. A code "42" (false alarm) is printed if the data was not identical three consecutive times as sensed by gate 3 and stored by bistable 2. After printing the bistable circuits are reset and the timing and control circuitry cause the next address to be interrogated.

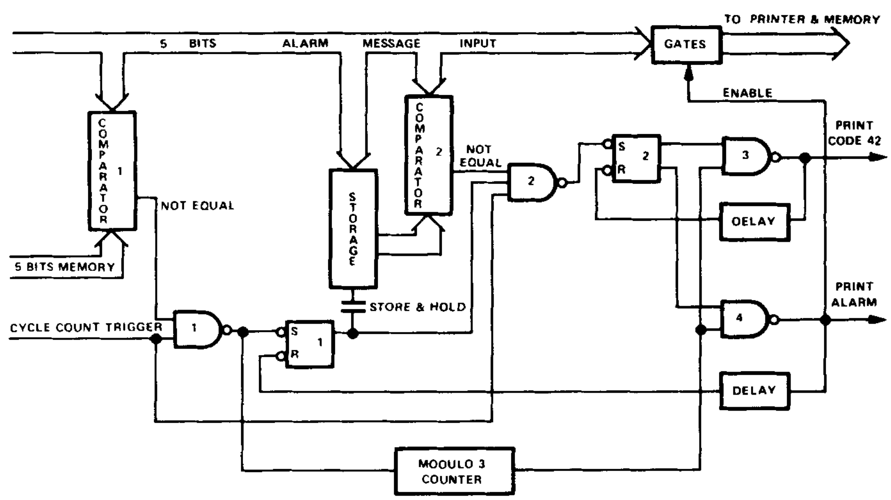

Figure 16 Alarm Comparator

APPLICATIONS

Transponder Data Inputs

The five data input lines to the transponder are coded a binary-coded octal. Data input one represents $(01)_8$; input two represents $(02)_8$; input three represents $(04)_8$; input four represents $(10)_8$; and input five represents $(20)_8$.

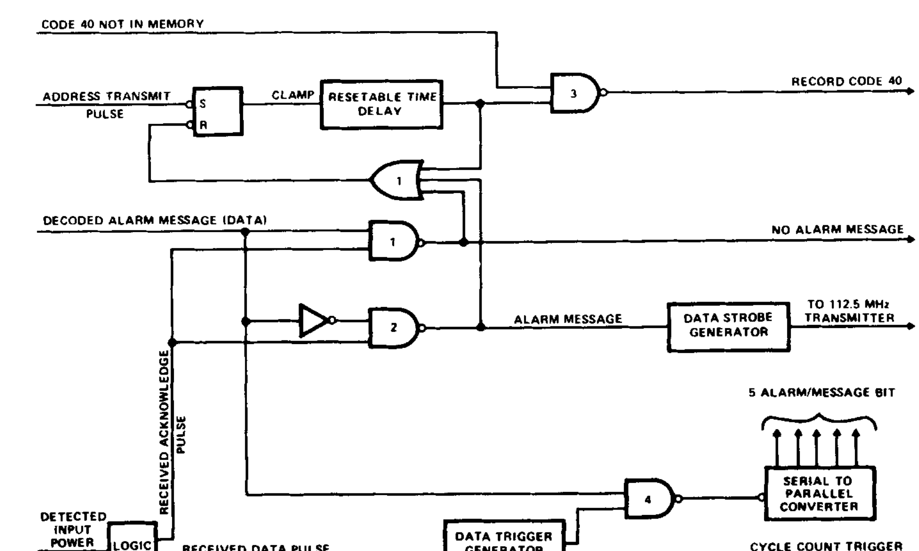

Figure 15 Demultiplexer & Data Register

The switch inputs are normally open contacts. Figure 17 shows a block diagram of five input switches S1–S5.

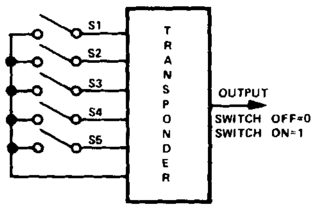

Figure 17
Five Independent Switch Inputs

Table 3 shows all possible combinations of the five switches. An "O" represents an open switch contact (an "off" condition) and a "1" represents a switch closure (an "on" condition). When all switches are off the transponder will transmit a $(00)_8$ code. When all switches are on the transponder will transmit a $(37)_8$ code. All other combinations are shown in the transmittal code column of Table 3.

Table 3 Transponder Input Codes

SWITCH	S1	S2	S3	S4	S5		TRANSMITTED CODE
LINE \ CODE	01	02	04	10	20		
1	0	0	0	0	0		00
2	1	0	0	0	0		01
3	0	1	0	0	0		02
4	1	1	0	0	0		03
5	0	0	1	0	0		04
6	1	0	1	0	0		05
7	0	1	1	0	0		06
8	1	1	1	0	0		07
9	0	0	0	1	0		10
10	1	0	0	1	0		11
11	0	1	0	1	0		12
12	1	1	0	1	0		13
13	0	0	1	1	0		14
14	1	0	1	1	0		15
15	0	1	1	1	0		16
16	1	1	1	1	0		17
17	0	0	0	0	1		20
18	1	0	0	0	1		21
19	0	1	0	0	1		22
20	1	1	0	0	1		23
21	0	0	1	0	1		24
22	1	0	1	0	1		25
23	0	1	1	0	1		26
24	1	1	1	0	1		27
25	0	0	0	1	1		30
26	1	0	0	1	1		31
27	0	1	0	1	1		32
28	1	1	0	1	1		33
29	0	0	1	1	1		34
30	1	0	1	1	1		35
31	0	1	1	1	1		36
32	1	1	1	1	1		37

GENERAL APPLICATIONS

The five data inputs may be used in two different ways. Each of five independent functions may be monitored to indicate an on-off condition. All combinations of the five independent inputs can be uniquely identified by the octal code as shown in Table 3. The switches represent inputs such as S1 for smoke or heat detection, S2 for intrusion detection, S3 for a "panic" alarm indicator. If fire occurs, code 01 is transmitted. If an intrusion occurs code 02 is transmitted. If fire and intrusion occur simultaneously then code 03 is transmitted.

The five data inputs may also be used to monitor 32 discreet levels of one input variable as shown in Figure 18. A remotely located transducer monitors a varying parameter. The analog output of the transducer is converted to binary-coded octal in an analog-to-digital converter. The range of measurements can be resolved into 32 discrete steps.

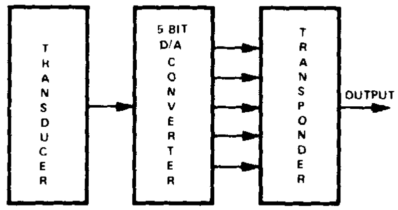

Figure 18 Using the Transponder For Monitoring One Input Parameter in 32 Discrete Measurement Levels

With optional circuitry (a multiplexer) the system can be expanded to transmit twenty bits of data. The increased system can be expanded to transmit:

1. Twenty independent on-off switch closures (Figure 19)
2. 1,048,576 discrete levels of one independent variable (Figure 20)
3. Combinations of the two above extreme cases.

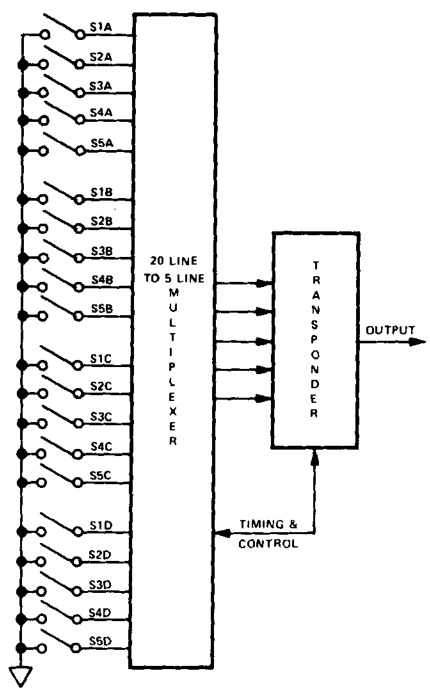

Figure 19 Using the Transponder for Sensing 20 Independent Switch Inputs

This is accomplished by using bits 15 and 16 of the interrogation word for byte control. There are four possible states of the two bits and each byte contains five bits of data. The subscriber station is interrogated four times to receive the twenty bits of data.

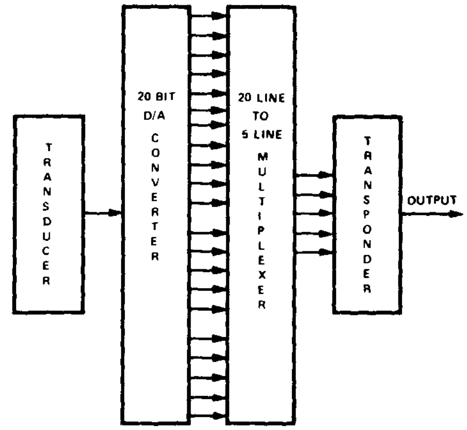

Figure 20 Using the Transponder For Monitoring One Input Parameter For 1,048,576 Discrete Measurement Levels

CONCLUSION

CATV distribution systems can be adapted for two-way data communications. The first type of communication system to be used will probably be a "polling" system such as the Security-Alert system discussed within this paper.

This system is available and can be used to increase the services offered to the subscriber.

Probably the first application of this system will be used to monitor and sense remote events such as fire and intrusion alarms. The system can monitor any switch closure and can also be adapted to monitor time varying parameters such as voltage, current or power. As more services are required by the subscribers the system can be expanded and adapted for uses such as:

1. Polling (program tuner and opinion)
2. Game playing
3. Remote control
4. Educational purposes
5. Information retrieval
6. Special program selection
7. Subscriber remote turn on - turn off service
8. Distribution system fault locating and reporting.

The future of two-way data communications utilizing the CATV cable promises to be an ever expanding field.