TEST AND EVALUATION

OF

[redacted] SIGNAL ACTIVATED DEVICE

STAT

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1. GENERAL

1.1. The following report covers the tests performed on the engineering model of a signal activated device (SAD) developed by [redacted] [redacted] The device is intended to be used with present and future video systems for the purpose of activating auxiliary components in the presence of a pulse type signal.

1.2. The results of the tests conducted will form the basis for recommending changes in later production models of the SAD.

2. DESCRIPTION

2.1. The signal activated device is a miniature electromechanical device used to operate a companion recorder for a predetermined period of 1.25, 2.5 or 5 minutes, or as long as signals are being received at the input of an associated amplifier. When the reception of signals ceases, the SAD provides coded time information to the recorder.

2.2. The SAD consists of the following components:

a) bi-stable multivibrator

b) standard watch movement

c) electromagnetic hack

d) printed circuit disc

A hack is an electromagnetic operator used to unlock a balance wheel on a watch mechanism.

2.3. The input to the signal activated device consists of negative polarity pulses approximately 5 microseconds in width and 50 millivolts in amplitude. On receipt of the first pulse, the bi-stable unit acts as a switch and applies voltage to the hack coil through an RC network. Operation of the hack starts the watch, which in turn drives a rotary contact arm. At the same time, the action of the hack closes a set of switch contacts to operate the associated recorder motor. The input signal also flows through a set of normally closed contact of a Neomite relay located in the SAD, to the magnetic record head. The watch continues to run for a predetermined period, after which time it connects a negative dc voltage to the coil of the Neomite relay. The flow of current through the relay coil closes the normally open contacts thereby removing the signal from the record head and impressing a 1000 cycle reference tone across the head. After this action, the signal activated device returns to its static state to await the presence of another signal.

2.3.1. The incorporated watch movement is wound by inserting a small screw driver in the slot of the large screw on the front of the unit, and winding in a manner similar to that used on a wrist watch.

2.4. The device is designed to operate from an external 6 volt dc source. The standby current drain is approximately 0.6 milliamperes at room temperature. During the period when a signal is being recorded, the current drain is approximately 22 milliamperes, and rises to 42 milliamperes when the reference tone is being recorded. The latter interval lasts 3 seconds during each cycle.

2.5. The signal activated device has the following overall dimensions: $3\frac{1}{4}$ in. long x $2\frac{1}{4}$ wide x 1 5/8 in. high. The total weight of the unit is approximately 8 ozs.

3. PROCEDURES AND RESULTS

3.1. The signal activated device was evaluated as an individual piece of equipment and as an integral part of a collection system. The former was performed to determine the operating characteristics of the device while the latter was performed to determine its ability to be used with present-day systems. Both portions of the evaluation are described in detail in the following paragraphs.

3.2. In testing the SAD by itself, a voltage source was connected to the device, and a signal source was connected to the input. Care was taken to use shielded cable whenever possible. A major problem immediately observed was the inherent instability of the bi-stable multivibrator reset circuit. The reset circuit would trigger the multivibrator upon application of the 6 volt dc battery, causing the unit to run for the pre-determined time. This condition is unwanted and seriously affects operating procedures. Another problem encountered was the extreme sensitivity (50 mv) of the device. The SAD operates on the principle of the signal input exceeding a certain amplitude level, and therefore is susceptible to noise transients of the required level. There is no input control on this unit, therefore the input sensitivity cannot be varied. Tests conducted on the SAD indicates the device will trigger when the input exceeds a 30 mv level. The timing cycles and overall mechanical operation was also tested to determine proper operation.

3.3. The signal activated device was next tested as part of a collection system, using the VA-5 and VR-3A systems. In both instances, signals were taken from outputs located in the video circuitry under proper impedance matching conditions. Upon activation of the amplifiers, with no signal applied, the SAD was triggered and continued to run until the amplifier was turned off. This was due to the noise levels of the amplifiers; the VA-5 unit having an output noise level of approximately 100 millivolts peak. The noise output of the VR-3A amplifiers was also sufficiently high to keep the SAD in continuous operation.

3.4. In order to permit a proper evaluation of the SAD under the modes mentioned above, a means had to be devised to overcome the inherent problems of the device. The methods used are included as an appendix to this report.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1. The signal activate device exceeds the operating specifications as requested by the customer. The device will operate on less than a 50 millivolt input level and a 5 microsecond pulse width. The unit is not reliable in its present status and cannot be used with existing video amplifiers, due to the high noise levels. The signal to noise ratio must be at least 2 to 1 with the noise level never exceeding 30 millivolts.

4.2. The switching procedures and timing of the device are accurate and functioning properly. Most of the troubles stem from the electronics used to activate the watch movement. Some of the recommended changes to improve the operation of the device are as follows:

a) use separate coaxial connector for signal input. If this is done, the signal lead should be removed from the 14 pin connector.

b) threshold control should be used and should be easily adjustable.

c) incorporation of circuitry to prevent triggering on random noise pulses.

d) incorporation of method to prevent triggering of SAD upon application of battery potential.

e) use of twisted pair wire with shield for battery leads.

f) dress leads from socket to printed circuit board.

g) route wiring from solenoid contacts under watch movement to prevent entanglement in watch gears.

h) improve soldering on all connections to prevent removal of plated surfaces.

i) bring out winding shaft to permit winding watch without removing case.

j) time set switch should be brought out to front panel to permit screw driver adjustment.

5. APPENDIX

5.1. The triggering of the SAD when the 6 volt battery potential was applied was overcome by inserting a 22 ohm resistor in series with the negative battery lead and shunting the battery leads with a 100 mfd. condenser. Upon application of the dc voltage, the instantaneous capacitor current is maximum. Therefore, the instantaneous voltage drop across the 22 ohm resistor is maximum. In the case of the SAD, the instantaneous voltage drop is 4 volts when 6 volts is applied, leaving only 2 volts applied to the device. This voltage is insufficient to operate the re-set circuit. After a short interval set by the RC time constants of the circuit, the capacitor will discharge and the full 6 volts potential will be applied across the SAD. It must be noted that a certain amount of time is required to discharge the capacitor when the dc potential is removed, and therefore, the device cannot be turned off and on without allowing a 10 second lapse of time.

5.2. The second problem encountered in evaluating the SAD was triggering due to the noise input. This feature will keep the device running continuously when connected to the output of any video amplifier presently available. A threshold control at the input will attenuate the noise and also the signal; therefore, a large signal-to-noise ratio must be presented to the input if the noise is to be attenuated sufficiently to prevent triggering.

5.2.1. A circuit which operates on the sync separator principle was developed to limit the amplifier-crystal noise before being applied to the SAD. This noise-limiting device is a self-contained unit consisting of two transistors and a number of other components. When used between the output of an amplifier and the input to the SAD, a 1.2 to 1, S/N ratio may be applied to the input of the noise limiter resulting in a minimum S/N ratio at the output of 5 to 1. The following is an example of the results obtained with the noise limiter:

a) minimum S/N levels at optimum threshold setting:

input signal = 60 mv peak	output signal = 50 mv peak
input noise = 50 mv peak	output noise = 10 mv peak

b) minimum signal level at maximum noise rejection threshold setting:

input signal = 320 mv peak	output signal = 50 mv peak
input noise = 50 mv peak	output noise = 0

The noise limiter was constructed as a separate black box for the tests. This caused the additional problem of contact potential between the noise limiter and the SAD. The contact potential was generated when the SAD, with power on, was connected to the noise limiter and was of such a level to activate the SAD. This difficulty was overcome by incorporating a 2700 ohm resistor in series with the signal input to the SAD.

5.3. The above-mentioned features permitted proper overall evaluation of the signal activate device. It would be possible to incorporate these features within the SAD without changing the physical dimensions of the unit.