GEORGIA INSTITUTE OF TECHNOLOGY — OFFICE OF CONTRACT ADMINISTRATION

PROJECT ADMINISTRATION DATA SHEET

[x] ORIGINAL [ ] REVISION NO. _____

Project No. A-3269 DATE 6/24/82

Project Director: Harris Johnson ~~School~~/Lab EDL/IED

Sponsor: Safety Signal Lights, Inc.

Type Agreement: Standard Research Project Agreement No. A-3269

Award Period: From 7/1/82 To ~~12/31/82~~ (Performance) 12/31/82 (Reports)

Sponsor Amount: $3,910 (Advance Payment) ~~6/30/83~~ 7/31/83 Contracted through:

Cost Sharing: _____ GTRI/~~GIT~~

Title: Testing and Engineering Assistance

ADMINISTRATIVE DATA OCA Contact Faith G. Costello x-4820

1) Sponsor Technical Contact:

Same as 2)

2) Sponsor Admin/Contractual Matters:

Preston H. Gibson
President
Safety Signal Lights, Inc.
2261 Debbie Ann Court
Auburndale, FL 33826

(813) 967-3382

Defense Priority Rating: N/A Security Classification: N/A

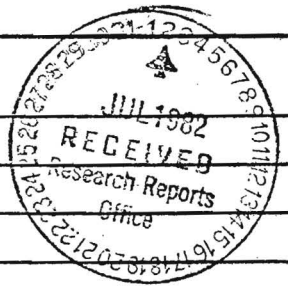
RESTRICTIONS

See Attached N/A Supplemental Information Sheet for Additional Requirements.

Travel: Foreign travel must have prior approval — Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of $500 or 125% of approved proposal budget category.

Equipment: Title vests with N/A

COMMENTS:



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FORM OCA 4:781

GEORGIA INSTITUTE OF TECHNOLOGY OFFICE OF CONTRACT ADMINISTRATION

2-A-3824/122

SPONSORED PROJECT TERMINATION SHEET

Date 9/14/83

Project Title: Testing and Engineering Assistance

Project No: A-3269

Project Director: Harris Johnson

Sponsor: Safety Signal Lights, Inc.

Effective Termination Date: 8/31/83

Clearance of Accounting Charges: 8/31/83

Grant/Contract Closeout Actions Remaining:

- [X] Final Invoice ~~and Closing Documents~~
- [ ] Final Fiscal Report
- [ ] Final Report of Inventions
- [ ] Govt. Property Inventory & Related Certificate
- [ ] Classified Material Certificate
- [ ] Other _____

Assigned to: EDL/IED ~~(School/Laboratory)~~

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Other JOHNSON

FORM OCA 10:781

SAFETY SIGNAL LIGHTS INC.

Accelerated Life Test

by
Harris T. Johnson, III
West Georgia Area Office
Georgia Institute of Technology
P. O. Box 676
Carrollton, Georgia 30117

TABLE OF CONTENTS

BACKGROUND

A novel and patented approach to providing additional railroad crossing safety has been developed by Mr. Preston Gibson and Mr. Raymond Knox of Safety Signal Lights, Inc.. This new circuitry is not intended to replace existing motion detection and/or complex signaling devices but rather to provide a lower cost switching function for rural crossings, thereby providing an enhanced warning device over passive warning signs on a larger number of crossings than is economically feasible today.

There are 219,082 public, 142,338 private, and 3,601 pedestrian grade level crossings which have averaged 1,328 fatalities and 3,680 injuries per year from 1967 through 1976[1]. Data from 1976 indicates that accidents at grade level crossings might be reduced by as much as 29% (8,347 vs. 11,700)[2] had all crossings been protected by at least some signal lights.

[1] Federal Register, Vol. 43, No. 45.

[2] Assumes that the proportion of accidents which would have occured anyway remains constant.

CIRCUIT DESCRIPTION

The circuitry itself is self-contained and designed specifically to be used on rural crossings. A low level signal voltage is induced across insulated sections of rail which in turn are shorted by the metal wheels and axle of an approaching train. Rail to rail voltage is constantly monitored, and should a system failure cause either an open circuit on the rail line or a short in the rail line the signals will flash continuously until the problem is corrected. Circuit control functions are implemented in standard CMOS logic with lamp driving circuits incorporated directly on the control board. Input circuitry is protected from lightning induced surges by semiconductor surge-suppressors. Only direct-hit and other physical damage causing strikes are expected to result in circuit failure. Each independent circuit card is designed to be operated in tandem with a second card (master - slave) for redundant circuit protection. Since the control circuits are designed to be operated on each side of a rail line (four cards: two master, two slave per crossing), the system incorporates significant redundancy.

SAFETY SIGNAL CORPORATION

Reliability Calculation [1,2]

(2) Reliability calculations inherently involve a detailed bill of materials for the device under consideration. Therefore, the calculations have been deleted for this report.

DESCRIPTION OF TEST CIRCUIT

In order to conduct an accelerated life test of 2,000 hours exposure at 70 $\pm$ 5^{o}C, a temperature controlled oven along with appropriate controls was assembled at the Carrollton field office of the Georgia Tech Engineering Experiment Station. The oven itself is an insulated Boekel 1,500 watt oven of approximately 2.75 ft.^{3} interior space (GT SN 001480). Temperature control for the oven was provided by an Omega Engineering controller model #6103-J-0/300F (SN 00973) calibration date 10/26/83. Rapid control temperature response was obtained with an air surrounded thermocouple type Omega Engineering C03-J with a rated 300 millisecond response time.

Static air temperature readings were monitored with a Taylor Surfamark precision thermometer #6335G. In order to verify temperature control, the oven and control circuitry were "run-in" for a seven day period just prior to test initiation. Test results indicated that for the period April 6, 1983 to April 13, 1983 once the oven reached a stable temperature of 69.5^{o}C that no preceivable long-term drift occurred. The external environment was an office environment ranging in temperature from more than 50^{o}F to less than 80^{o}F. Over this temperature range the oven's response was sufficiently more rapid than the environmental change in temperature so that no perceivable change in internal temperature occurred.

It is estimated that maximum heat dissipation from the installed circuit cards (exclusive of the lights themselves which were exterior to the oven) was 50 watts. To simulate the installed cards two 5Ω, 20 watt resistors were installed and over-driven to 2¼ amps (2.25^{2} X 5 X 2 $\simeq$ 50 watts) for 15 minutes. No perceivable temperature rise was observed.

The four circuit cards were installed by mounting on a specially designed rack in the vertical (normal) position with the edge on which the relay is mounted on the down side. The circuit ground plane mounting holes were used with four 6-32 screws and associated nuts and lock washers. Contact area between the mounting bracket and the circuit card is < 5 in.^{2}. The mounting bracket itself is constructed of .062" X 1" C.R.S. and is not considered to be a major thermal component.

Entrance to the oven for power wires, etc. was made via access holes on opposite walls of the oven itself. Wiring was by custom harness of AWG16 PVC insulated, stranded wire. The following circuits were implemented.

(1) Power supply - + and - 12VDC

(2) Output - 4 wires per card, 2 master cards wired, 2 slave cards wired parallel with master cards

(3) Control - "A" and "B" rail inputs for each card pair - Rail common*

(4) Start/stop - Master card pins 5, 6, 7 for each card pair

Each rail was simulated by 2-parallel 1,000 Ω, ½ watt resistors between the rail input and rail common (external to the oven).

*Although rail common is electrically the same as -12VDC, the contacts were made inside the oven.

DESCRIPTION RESULTS - ACCELERATED LIFE

The life test designed for this circuit consisted of a 2,000 hour temperature soak at 70 $\pm$ 5°C. In order to simulate active rail activity, the test was conducted at a 50% duty cycle. That is, a train was siumulated by shorting the "A" input to rail common for 15 minutes and then removing the short for 15 minutes. Successful circuit performance during the test was defined to be a "signal flashing" condition as indicated by actual flashing lights during the "active rail activity period". Two separate test sets were run; one on master-slave card set 1 and one on master-slave card set 2. "A" inputs for both circuits were shorted.

A small rack was constructed to hold standard automotive lamp sockets which in turn held GE 25W, 10V signal lamps. The rack was placed immediately to one side of the test oven where circuit failure would be readily apparent. The power supply for this test was a standard automotive 12V battery which in turn was held in a charged condition by a constantly attached Schaner Model 0232-17 automotive battery charger.

Rail activity was implemented by using the normally open contacts of an Automatic Timing and Control Co. type 342A200Q10PX industrial timer. Prior to test initiation the timer was adjusted to provide a precise 15 minute on, 15 minute off cycle.

Prior to test initiation a performance check of both shorted and open conditions for both "A" and "B" inputs was conducted.

Pre Test Inspection

	"A" Input		"B" Input	
	Shorted	Open	Shorted	Open
Master 1	✓	✓	✓	✓
Slave 1	✓	✓	✓	✓
Master 2	✓	✓	✓	✓
Slave 2	✓	✓	✓	✓

Successful inspection consisted of control card entering a flashing condition for each of the above elements.

The life test was begun April 14, 1983 at 12:00 noon. Initial monitoring of both temperature and flashing, as well as relaxed condition, occurred every five minutes for the first two hours and on 30 minute intervals through 5:30 p.m. on that date. Subsequent monitoring occurred on a regular basis throughout the business week with weekend and holiday monitoring occurring at a minimum of twice per day.

An interim check of card pair* performance was conducted on May 30, 1983 (approximately 1,100 hours into the test) with the following results:

Interim Inspection

	"A" Input		"B" Input	
	Shorted	Open	Shorted	Open
Master Slave 1	✓	✓	✓	✓
Master Slave 2	✓	✓	✓	✓

On Friday, June 3 at approximately 4:15 p.m. Lamp #1 (pin out #'s 10, 11) of master slave set number 2 burned out. It was replaced within 30 minutes, and the circuit continued to operate correctly thereafter.

On Thursday, June 16 at approximately 2:00 p.m. Lamp #1 of master-slave set number 1 burned out. It was replaced within 30 minutes, and the circuit continued to operate correctly.

At approximately 1:30 a.m. July 7, 1983 the test was terminated by turning off the oven and disconnecting the power supply. Immediately prior to test termination, the circuits were operating properly in the flashing mode. The oven was allowed to cool slowly. Only July 29, 1983 a post life inspection with the same criteria as the prelife inspection was conducted. The results were:

Post Life Inspection

	"A" Input		"B" Input	
	Shorted	Open	Shorted	Open
Master 1	✓	✓	✓	✓
Slave 1	✓	✓	✓	✓
Master 2	✓	✓	✓	✓
Slave 2	✓	✓	✓	✓

Results - all four circuit cards met the prescribed criteria of flashing on either shorted or open rail conditions both prior to and following a 2,000 hour accelerated life test at 70± 5°C.

*Card pairs were inspected so as not to disturb the test by unwiring and rewiring the master-slave card arrangements.

SHOCK TEST

A fifth test unit, henceforth designated master 3, was subjected to a normal handling shock test. For this test the unit (15.4 oz.) was mounted on the test bracket (3 lb. 10½ oz.) in the normal mounting manner. A socket mounted relay which is held in by a spring clip was removed prior to the test since if (during handling) the relay should become knocked loose, it would be readily repairable on site.

Three shocks each in each of three mutually perpendicular planes were administered. Each shock consisted of a single blow to the mounting frame from a 4 lb. mass which rotated through a 42" arc.

Following the six successive blows the relay was reinserted and the unit tested for entering a flashing condition on either open or short rail inputs "A" or "B".

Post Test Inspection

	"A" Input		"B" Input	
	Shorted	Open	Shorted	Open
Master 3	✓	✓	✓	✓

SCHEMATIC

The schematic for this device has been deleted from this report due to the proprietary nature of the product.

PICTURES

"8 X 10" color pictures of the circuit itself, the test fixture, and the test environment were included in sponsor copies of this report.