

AC Load Switching With ChipSwitch® Microelectronic Relays

AN-100

(ChipSwitch is a trademark of International Rectifier)

by Stan Schneider

Introduction

Electromechanical relays (EMRs) used for switching AC lines have limited useful lives due to mechanical wear out and contact sticking and erosion. These problems are accentuated under inductive loads or the surge conditions experienced when driving incandescent lamps. Under these conditions relay life varies from 10^4 to 10^6 operations.

The ChipSwitch Relay

The ChipSwitch microelectronic relay developed by International Rectifier is a solid state device specifically designed to overcome EMR problems through the use of electronic power switching. Mechanical fatigue and contact arcing problems under inductive loads, for example, are totally non-existent. Because of this superior performance, ChipSwitch relays offer designers a far better solution where reliability of operation and the high cost of service are important factors.

Power IC Approach

The use of an integrated circuit approach to zero-crossing, photosensing and power switching combined with the use of the highly advantageous dual SCR output, produces a microelectronic relay with a very long switching life. In order to determine the switching life of the ChipSwitch SSR a number of characteristic loads were selected. These included contactor coils, solenoid valves and incandescent lamps. These loads presented a wide variety of severe operating conditions. The test data in this application note indicates a minimum life of 10^7 operations with no upper limit yet established — demonstrating that the ChipSwitch relay's switching life exceeds that which can be achieved by EMR devices. The lack of any deterioration in the ChipSwitch test samples further indicates that actual life is much greater.

SOLENOID VALVES

Scope: To determine the feasibility of employing the CS6005 and CS6010 ChipSwitch relays to switch solenoid operated gasoline valves.

Life Test Description: Two typical dual flow rate valves were selected and set up to be switched by ChipSwitch

solid-state relays. Each of the valves selected used two ChipSwitch devices to operate at the two flow rates required.

For each valve two tests were run: one full-off to full-on; and the second full-off to full-on to half-on (low flow rate).

TEST I

Valve:	Skinner XLG2R470C
Relays:	Two ChipSwitch CS6010 (CS6005 is identical except for turn-on current).
Test A:	Both coils on and off simultaneously (Full-on, Full-off). Input Current (each ChipSwitch): 10 mA DC Cycle Length: 1 Sec. Duty Cycle: 50% Steady State Operating Current ChipSwitch 1: 180 mA AC Peak ChipSwitch 2: 180 mA AC Peak Test Duration: 2,074,000 Cycles
Test B:	Both coils on simultaneously, low flow rate coil on only, off Input Current (each ChipSwitch) 10 mA DC Cycle Length: 3 Sec. Duty Cycle: 1 Sec. Full on 1 Sec. Low Flow Rate 1 Sec. Off Steady State Operating Current Full On ChipSwitch 1: 180 mA AC Peak ChipSwitch 2: 180 mA AC Peak Low Flow Rate ChipSwitch 1: 180 mA AC Peak ChipSwitch 2: 0 Test Duration: 864,000 Cycles Total Test Duration: 2,938,000 Cycles

TEST II

Valve: ASCO 8292

Relays: Two ChipSwitch CS6010

Test A: Both coil and diode circuit on and off simultaneously (Full on, Full off)

Input Current: 10 mA DC
 Cycle Length: 1 Sec.
 Duty Cycle: 50%

Steady State Operating Current

ChipSwitch 3: 270 mA
 ChipSwitch 4: 150 mA

Test Duration: 3,197,000 Cycles

Test B: Both coil and diode circuit on simultaneously, coil on only, off.

Input Current: 10 mA DC
 Cycle Length: 3 Sec.
 Duty Cycle: 1 Sec. Full On
 1 Sec. Low Flow Rate
 1 Sec. Off

Steady State Operating Current

Full on
 ChipSwitch 3: 270 mA AC Peak
 ChipSwitch 4: 150 mA AC Peak

Low Flow Rate:
 ChipSwitch 3: 170 mA AC Peak
 ChipSwitch 4: 0

Test Duration: 864,000 Cycles
 Total Test Duration: 4,061,000 Cycles

Life Test Results

The ChipSwitch relays were removed from the circuit after each test and completely checked for any detrimental effects to the operating characteristics. Each SSR was found to be in perfect operating condition and no degradation in any specification was detected.

Conclusion

The tests performed show that the ChipSwitch CS6005 and CS6010 microelectronic power IC relays can successfully and reliably operate solenoid controlled valves. □

CONTACTORS AND INCANDESCENT LAMPS

Scope: To determine the feasibility of employing the ChipSwitch CS6005 and CS6010 microelectronic relays to switch size 1 and size 2 contactors and incandescent lamps.

Life Test Description: Both size 1 and size 2 contactor and a 25 watt incandescent lamp were selected and set up to be operated by ChipSwitch relays. The size 1 contactor, the size 2 contactor, and the incandescent lamp were each driven by a single ChipSwitch. The test in all cases consisted of a simple on/off sequential operation.

TEST I

Contactor: Telemecanique (Gould) Size 1 Contactor
 Catalog #A203C,
 120 VAC Coil (38 Ohm Dc Resistance)

Relay: ChipSwitch CS6010 (CS6005 is identical except for turn-on current).

Control Input: 10 sec, 10 mA pulse, 20 sec. period

Test Data

	Open	Sealed
Line Voltage:	120 VAC	120 VAC
Current:	1.65A RMS	0.20A RMS
Phase Shift:	56 Deg.	73 Deg.
Power Factor:	0.56	0.29

Contactor closes within 1 cycle

Test Duration: 1,132,000 Cycles

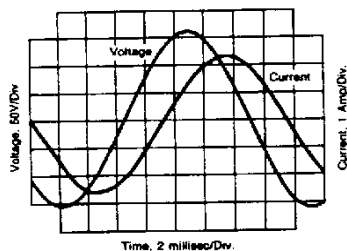


Figure 1. Open Condition

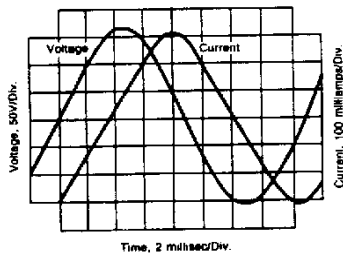


Figure 2. Sealed Condition

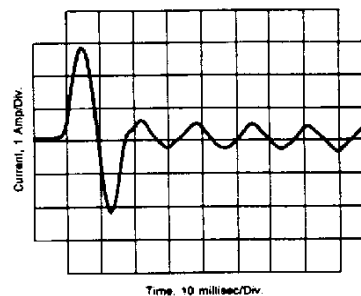


Figure 3. Switched Coil Current

TEST II

Contactor: Westinghouse size 2 Contactor
 Catalog #A201K2CA
 120 VAC coil (41 ohm DC resistance)

Relay: ChipSwitch CS6010

Control Input: 10 sec, 10 mA pulse, 20 sec. period

Test Data

	Open	Sealed
Line Voltage:	120 VAC	120 VAC
Current:	1.34A RMS	0.20A RMS
Phase Shift:	56 Deg.	73 Deg.
Power Factor:	0.56	0.29

Contactor closes in 1 cycle
 Test Duration: 1,132,000 Cycles

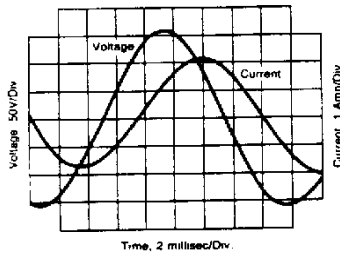


Figure 4. Open Condition

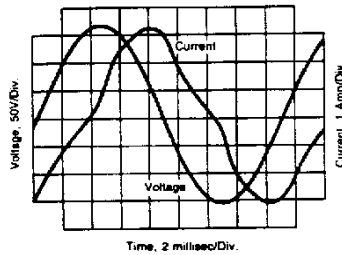


Figure 5. Sealed Condition

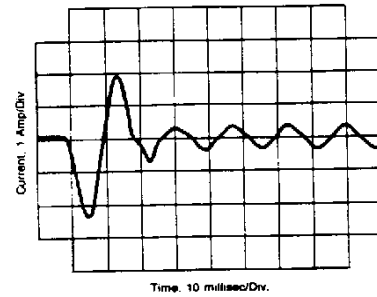


Figure 6. Switched Coil Current

TEST III

Lamp: 25 Watt Incandescent Lamp
 120 VAC filament

Relay: ChipSwitch CS6010

Control Input: 10 sec, 10 mA pulse, 20 sec. period

Test Data

Line Voltage: 120 VAC
 Peak Current: 1.6A 1st 1/2 cycle
 Steady State: 0.25A RMS
 1st 1/2 Cycle: 0.70A RMS
 1st Full Cycle: 0.39A RMS

Lamp Current stabilizes rapidly in first cycle.

Test Duration: 1,132,000 Cycles

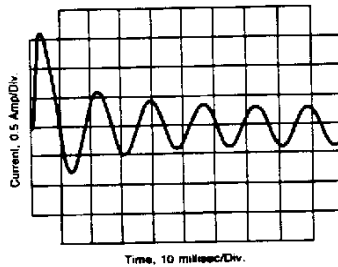


Figure 7. Lamp Current

Lamp load rating is determined by the steady state current of the lamp independent of the flashing rate.

Life Test Results

The ChipSwitch devices were removed from the circuit after each test and completely checked for any detrimental effects to the operating characteristics. Each SSR was found to be in perfect operating condition and no degradation in any specification was detected.

Conclusion

The test performed shows that the ChipSwitch CS6005 and CS6010 microelectronic power IC relays can successfully and reliably operate the size 1 and size 2 contactors and incandescent lamps. □