UNION SWITCH & SIGNAL

Union Switch & Signal Inc., an Ansaldo Signal company
1000 Technology Drive, Pittsburgh, PA 15219 • 645 Russell Street, Batesburg, SC 29006

Shelf-Mounted, Solid State, Vital, Biased, Code Following Track Relay

US&S Part No.
N40700408
N40700409

- Installation
- Operation

SM 9278, August 2005
Original

Proprietary Notice

Important Notice

US&S constantly strives to improve our products and keep our customers apprised of changes in technology. Following the recommendations contained in the attached service manual will provide our customers with optimum operational reliability. The data contained herein purports solely to describe the product, and does not create any warranties.

Within the scope of the attached manual, it is impossible to take into account every eventuality that may arise with technical equipment in service. Please consult your local US&S Account Executive in the event of any irregularities with our product.

We expressly disclaim liability resulting from any improper handling or use of our equipment, even if these instructions contain no specific indication in this respect. We strongly recommend that only approved US&S spare parts be used as replacements.

Revision History

Rev.	Date	Nature of Revision
Original	August 2005	Initial Release of Manual

Table of Contents

List of Figures

List of Tables

1 Introduction

This service manual provides installation and operation information for Union Switch & Signal's shelf-mounted family of solid state, biased, code following track relays (Figure 1-1). These relays provide a solid state option for customers with existing electromechanical track relays.

Table 1-1 cross references the US&S solid state, shelf-mounted relays to the US&S electromechanical CD style "cookie jar" packaged relays. Table 1-2 presents a list of considerations to be evaluated when using these solid state relays.

The solid state CD style relay is a code following relay comprised of two circuit boards, one control board and one output or "contact" board containing the solid state switches. The two boards are housed in a W400 style enclosure. The connections to a unit are made via standard AAR terminals available through the top of the unit.

On the output board, one solid state switch is used as the front contact, and one is used as a back contact for each of the four sets of contacts. All of the switches are normally open devices, therefore, to emulate a back contact, it is necessary to apply steady energy to one set of terminals on the upper terminal block to enable the back contact switches. Applying energy to another set of terminals activates the front contact switches and opens the back contact switches. In the event that back contacts are not required, it is still necessary to apply steady energy to the track version of the relays.

Solid state track relays operate as a four-front, four-back relay only.

The circuit boards are populated for low voltage applications. The low voltage unit can support load currents to 2.5 amperes to 30 VDC, 22 volts Vrms AC. Breakdown voltage across a normal-reverse contact set is limited by the surge protection ratings of 34 VDC for low-voltage contacts

Figure 1-1 - Typical Shelf-Mounted Code Following Relay

Table 1-1 - Cross References for Solid State/Electromechanical CDP Relays

Older CDP Style Relay	Recommended Operating Current	Ohms	Contacts	Solid State Replacement	Contact Application
N216371 N232752 N232753 N275968	0.82A	0.3	4FB LV	N40700408	4FB LV AC/DC #1,2,3,4
N232763	0.82A	0.3	1FB HV #1, 3FB LV #2, #3, #4	N40700409	1FB HV AC Only #1 3FB LV AC/DC, #2, #3 and #4

The shelf-mounted, solid state, biased, code following relays have a low input impedance and are to be used in code following track circuit applications.

The main difference between the solid state relay and the electromechanical relay is that a steady energy source must be connected.

1.1 Application Considerations

Other than the obvious difference that a steady energy supply must be used to replicate operation of an electronic code following relay (ECFR) to its electromechanical code following relay (EMCFR) counterpart, there are differences that need to be considered that relate to safety.

The differences between the ECFR and EMCFR are presented in Table 1-2.

1.1.1 Overcoming Contact Dependence

In some safety critical applications a vital relay is steady energized proving that the EMCFR is following code. The general way in which this is accomplished is illustrated in its simplest form in Figure 1-2.

A snub on AFP and ABP delays drop-out for sufficient time so that AFP and ABP remain steadily energized as long as A is following code. When coding stops either AFP or ABP drops as does AP. This technique is valid with EMCFR's because a front and back cannot simultaneously be closed. This technique is not valid for the ECFR because the contacts are independently driven and can be simultaneously closed. The contacts are not independently driven. The same function can be accomplished with an ECFR in one of two ways as shown in Figure 1-3.

Circuit A of Figure 1-3 uses a single transfer contact and diodes to achieve a voltage negative with respect to N12; Circuit B accomplishes the same function with marginally better efficiency using two transfer contacts. In either case, AP, will energize when A is following the code. It is a vital mechanism that ensures AP will deenergize when A is not following the code. It overcomes the problem inherent with ECFRs that shorting of front and back contacts together is a possibility. The circuit elements to duplicate these circuits are packaged on a PC board that is compatible with relay rack mounting. The one for the GRS B1 relays is part number N39903801 and the one compatible with

the US&S shelf-mounted style relays is N39903701. The N39903701 module is rack mountable in a PN-150 form factor.

Table 1-2 - Differences in Application of EMCFR and ECFR Relays

	EMCFR	ECFR	Recommendation or Comment
Calibration	Pick-Up and Drop-Away are determined by the force generated by a magnetic structure and the restraining forces of contact springs and/or magnets. It is implied that pick-up and drop-away are thus assured.	Pick-up and Drop-Away are primarily determined by current sensing devices for which there is no implied guarantee that it will never change. These devices have proven highly repeatable but calibration should not be regarded as absolute.	Calibration is performed at the factory during manufacturing using electronic devices that should not need further adjustment. These relays are designed to operate in the range of their electromechanical counterparts.
Contact Dependence	Contacts are driven by a common element and, therefore, a welded contact will prevent opposite state contacts from conducting.	Contacts are independent. A shorted contact, analogous to one that is welded, will not inhibit the others from functioning normally.	Do NOT use an ECFR in an application where dependent contact operation is critical to safety. (An example of overcoming this problem is presented in Section 1.1.1)
Inductive Load Switching	Preferred practice in switching inductive load relays is to snub the load to prevent arching, EMI, and contact corrosion.	Transient protection is an integral part of the solid state switches.	External snubbing and arc suppression devices are unnecessary. Line-to-line and line-to-ground arrestors are recommended for circuits that exit the house or case.
Short Circuit Protection	A short circuit can damage the relay and possibly initiate a fire in the wiring	With the low voltage contacts, a short circuit will cause no damage to the wiring or the ECFR	There should be less concern about short circuits with the ECFR.
Code Following Integrity and Reliability	Contacts open and close substantially matching the ON time of the code but erode with time; this causes code ON time distortion and eventually contact failure. The rate of contact failure is accelerated at higher code rates and contact loading. In cab signal applications, the point on the waveform of circuit interruption is random.	Code ON time is more consistent. There is no wear out mechanism and, therefore, no degradation of performance regardless of code rate and contact loading. **For High Voltage Only** – In cab signal applications, the point of circuit interruption occurs at the zero crossing resulting in less harmonic noise generation than would otherwise occur.	For those applications wherein the code follower is repeating ON-OFF switching from a code generator, the ECFR is a superior device.

1.2 Glossary

Coded Energy — The signal that activates alternate closure of the front and back contacts.

Steady Energy — The voltage applied to the relay so that the contacts alternately switch when coded energy is applied.

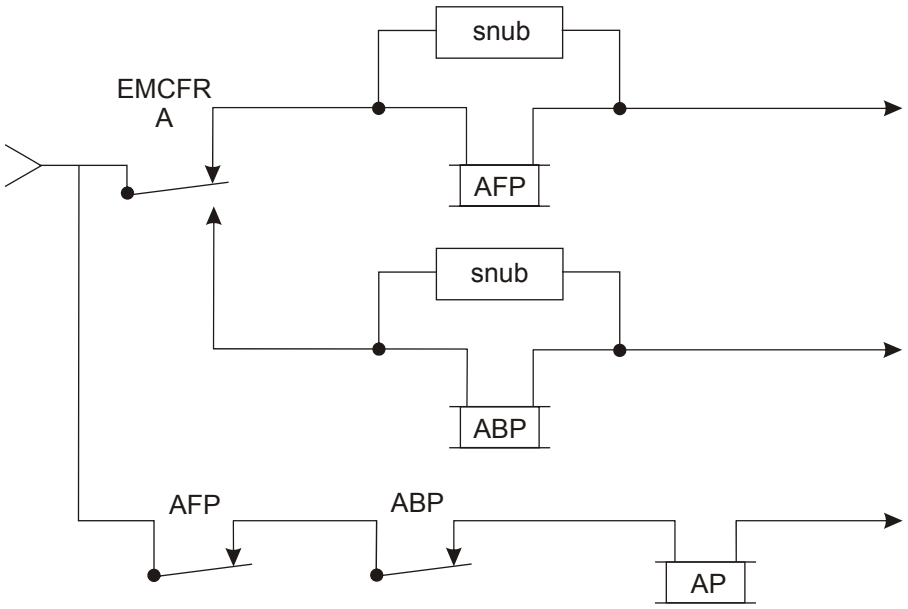

Figure 1-2 - Steady Energized Relay (EMCFR)

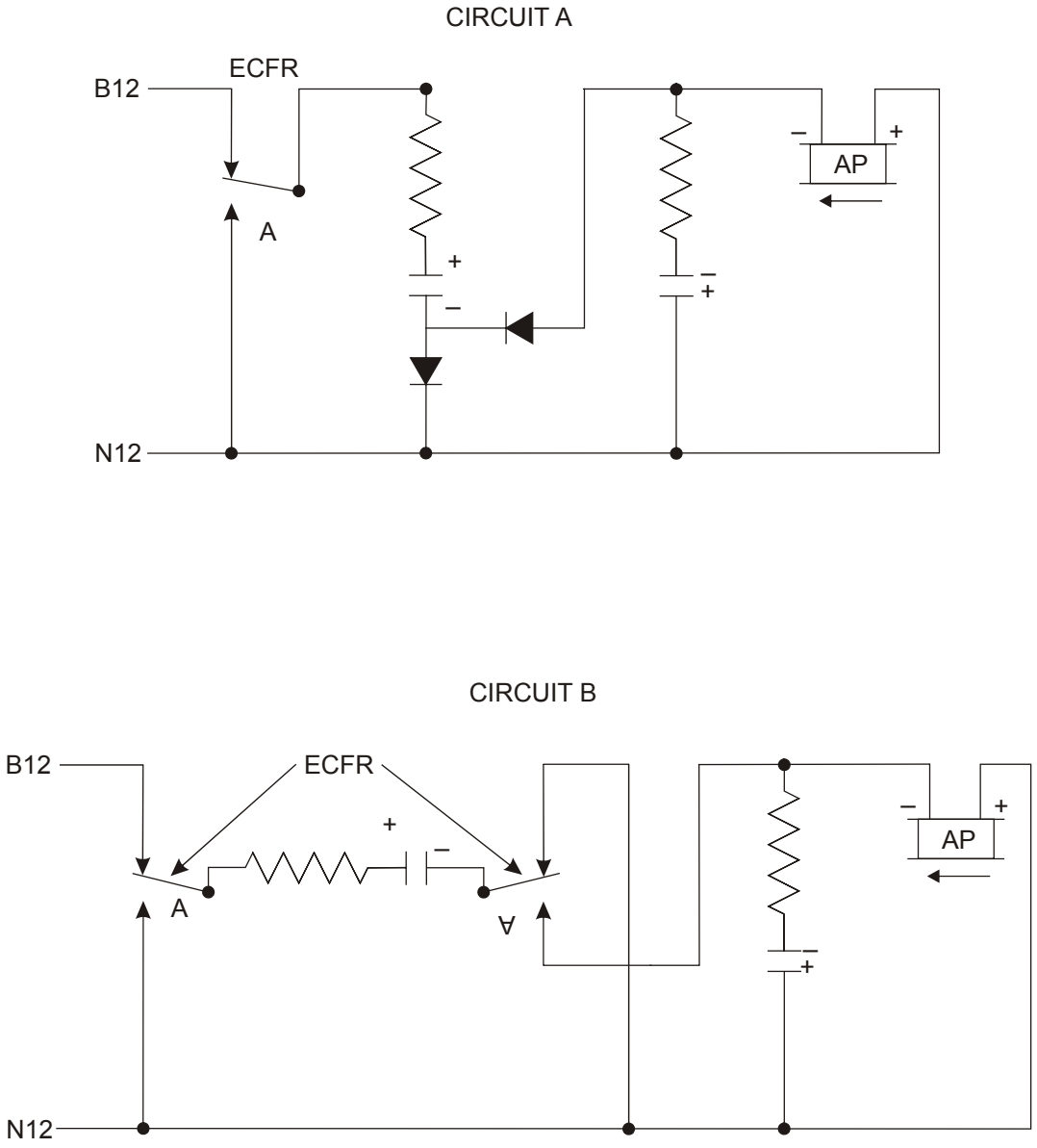

Figure 1-3 - Independent Contacts with ECFR

2 Equipment Description

2.1 Contacts and Current Ratings

The relay is for low voltage applications, and an AC/DC switch is provided. The load rating is 2.5 amperes per contact up to 30 volts DC and 22 Vrms. Low voltage contacts are protected up to 34 volts and are short circuit protected.

Breakdown voltage across a normal-reverse contact set is limited by the surge protection ratings of 34 VDC for low-voltage contacts.

2.2 Isolation for Biased Solid State Relays

The steady power source and coded inputs are isolated by 1000Vrms. Contacts and inputs are isolated from each other and the frame; the withstand voltage is 1500Vrms. Breakdown voltage across a front-back contact set is limited by the surge protection ratings of 34V.

2.3 Voltage Requirements

The operating voltage for the steady energy input of the relay is 8 to 16 VDC. Ripple must be limited so that the instantaneous voltage does not drop below 8 volts.

Table 2-1 - Specifications for the Solid State Code Following Track Relay

Parameter	Value
Operating Voltage	8 to 16 VDC (can not drop below 8 VDC) -
Contact Load Rating	Hold Current 0.06 to 2.5 Amps Voltage 12 to 230 Vrms
Contact Protection	Up to 230 volts (Contacts are NOT short-circuit protected. External fusing is required for short circuit protection.)
Operating Temperature Range	-40°C to +70 °C
Overall Dimensions	Height 9.25” Width 4.56” Length 6.0”

3 Installation

The shelf-mounted, solid state relays may be installed either on a horizontal shelf or mounted to a panel and installed in an equipment rack. The shelf-mounted relays do no use index plates. The dimensions for installing the relay are presented in Figure 3-1.

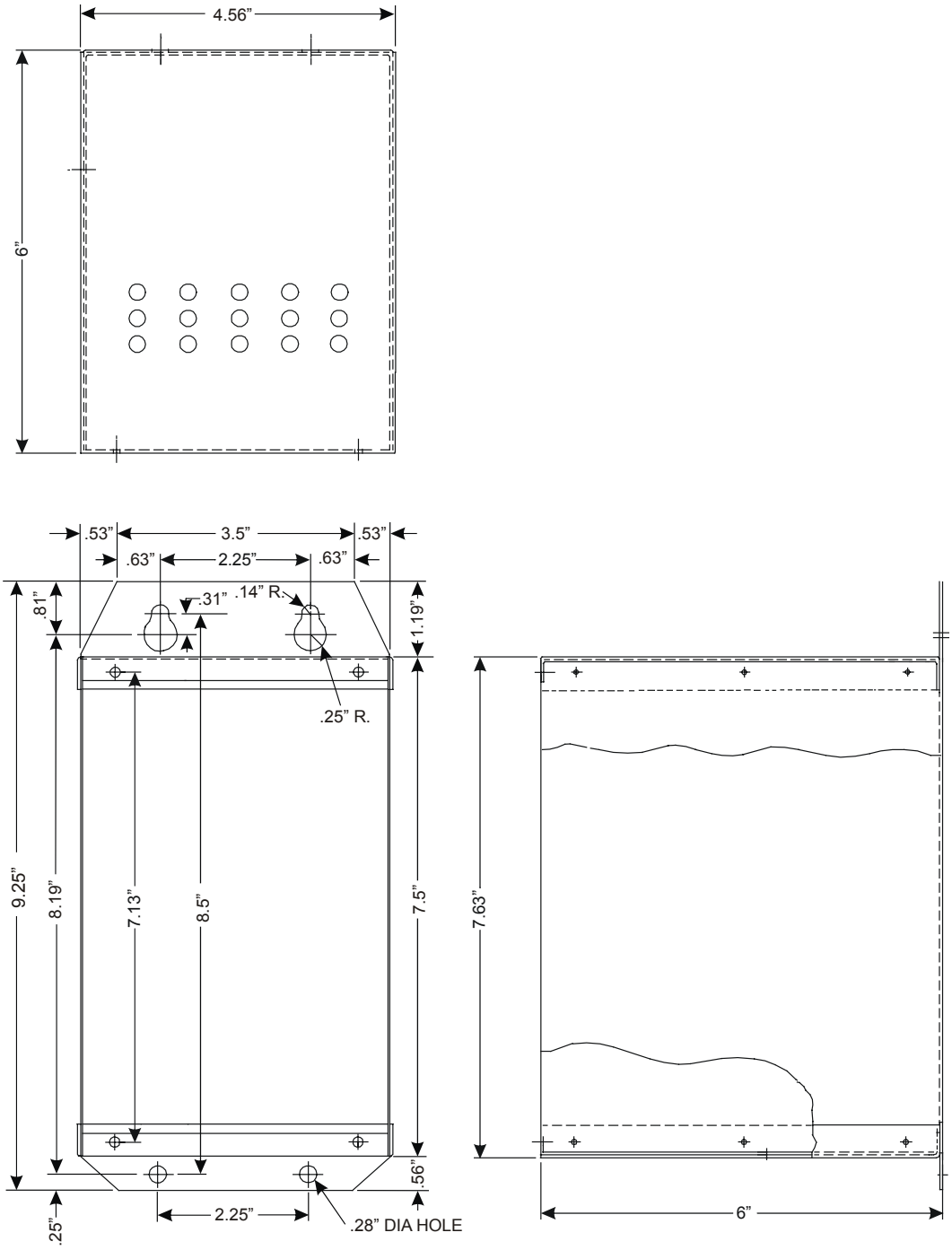

Figure 3-1 - Overall Dimensions of the Solid State Code Following Track Relay

3.1 Relay Wiring

For the shelf-mounted, solid state relay, the coded and steady energy inputs are connected to AAR terminals on the top of the unit. Positive coded energy is wired to terminal Coded+ and negative coded energy is wired to terminal -Coded. Positive steady energy is wired to terminal +12 Steady and negative steady energy is wired to terminal –12 Steady (see Figure 3-2).

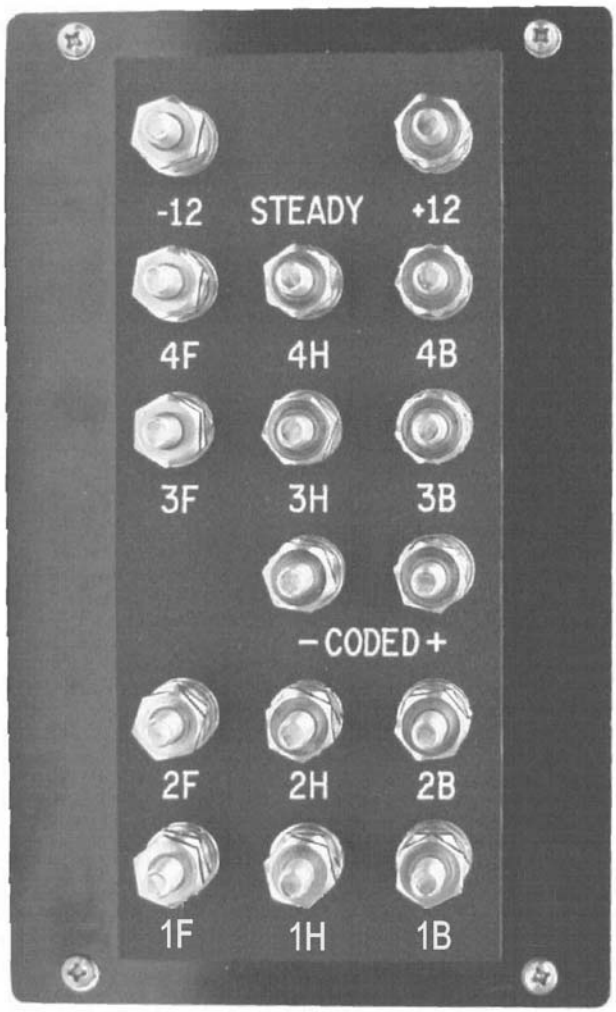

Figure 3-2 - External Connections for the Shelf-Mounted Track Relay (Viewed from the Top of the Relay)

4 Operation/Testing

4.1 Operation

Operation of the shelf-mounted, solid state code following track relays is identical to the electro-mechanical styles. A break-before-make characteristic is built into the electronics and the delay is approximately 1ms.

4.2 Test Procedure

No periodic testing or adjustment is necessary. There are no calibration procedures or adjustments that are required for the solid state shelf-mounted relays.

Testing a solid state relay differs slightly from testing an electromechanical relay. A minimum operating voltage replaces the pick up calibration. Testing consists of energizing the relay's steady input with 12 volts DC and then setting the pickup current. An AC source is used to indicate contact closure.

To test the shelf-mounted relay, connect it to a test fixture wired as shown in Figure 4-1.

1. Turn on the AC power by closing SW1. Lamps L5, L6, L7, and L8 should be illuminated. When the relay is under power (steady input), the back contacts are connected.

2. Connect a digital voltmeter set to measure DC volts across the test jack terminals. Close switch SW2.

3. Slowly increase the current by turning the potentiometer while observing the voltage reading. Because the voltage reading is taken across a 1Ω resistor it translates directly into a current reading. Hence a reading of 1Volt indicates 1 Ampere flowing into the coded input. When the lamps L1, L2, L3, and L4 illuminate and the lamps L5, L6, L7, and L8 become dark the relay has picked up.

4. The pickup voltage reading for the relays should be in accordance with Table 4-1.

5. If the relay fails the test, US&S recommends returning the relay to their Batesburg, SC facility for repair.

Table 4-1 - Relay Pickup Current

Relay Part Number	Pickup Current Range
N40700408	0.60A to 0.78A
N40700409	0.60A to 0.78A

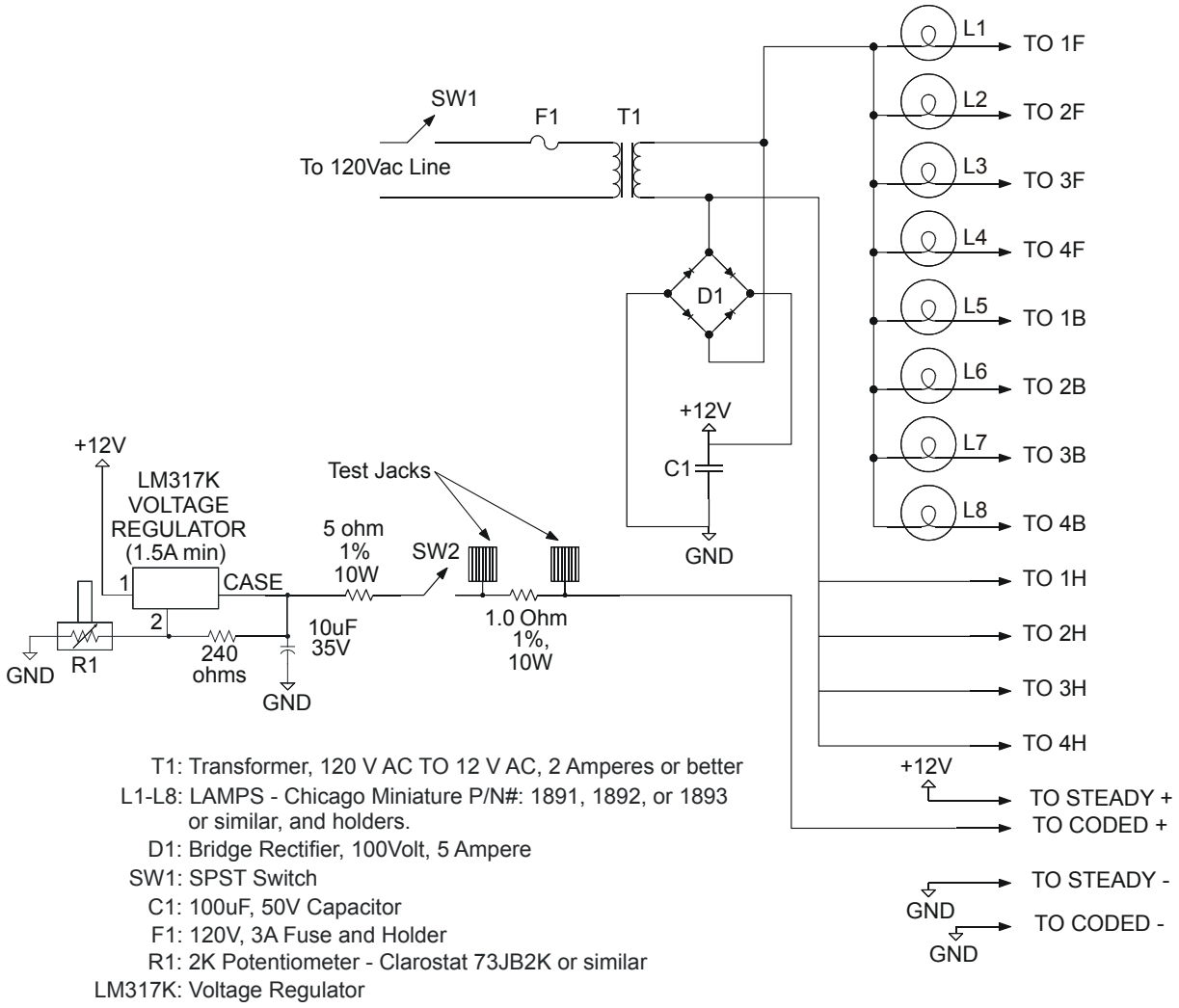

Figure 4-1 - Test Fixture for the Solid State Code Following Track Relay

5 Technical Support

The Rapid Action Information Link Team (RAIL Team) is a group of experienced product and application engineers ready to assist you to resolve any technical issues concerning this product. Contact the RAIL Team at 1-800-652-7276 or by e-mail at railteam@switch.com.