UNION SWITCH & SIGNAL

Union Switch & Signal Inc., an Ansaldo Signal company

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Shelf-Mounted Style Solid State Code Transmitter

(N407016XX)

(Replacement for DM Style Electromechanical and DM Style Solid State Code Transmitter)

US&S Part No.
N40701601
N40701602
N40701603
N40701604
N40701605
N40701606
N40701607
N40701608
N40701609

- **Installation**
- **Operation**

SM 8524A, August 2005
Original

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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

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1 Introduction

1.1 Introduction and Applications

The shelf mounted solid state code transmitter (SSCT) (Figure 1-1) is designed to be a functional electronic replacement for the Union Switch and Signal (US&S) DM style electromechanical and DM style solid state code transmitters. The original electromechanical DM style code transmitter is a relay that needs to be periodically inspected and serviced. The shelf-mounted SSCT, like the DM style SSCT, contains only electronic components. The only difference between the DM style and the shelf-mounted SSCT is the package and contact arrangement.

Code transmitters turn an AC or DC input on and off at a specific rate. Standard electromechanical DM SSCT units are available for transmitting at nominal rates of 50, 75, 120, 180, 275, and 420 cycles per minute (cpm). Other rates are also available by customer order. The shelf-mounted SSCT relays replace the most popular code rates of 75, 120, and 180 cpm.

1.2 Purpose of Manual

This service manual provides descriptive information, specifications, and installation and maintenance procedures for the shelf-mounted SSCT.

Figure 1-1 - Shelf-Mounted SSCT

1.2.1 Abbreviations and Acronyms

Table 1-1 lists the abbreviations and acronyms used in this manual.

Table 1-1 - Abbreviations and Acronyms

Term	Definition
A	Ampere
AAR	Association of American Railroads
AC	Alternating Current
CAUTION	Caution statements indicate conditions that could cause damage to equipment.
Cpm	Cycles per minute
DC	Direct Current
DM Style	The designation for a line of US&S electromechanical code transmitters in cylindrical enclosures with AAR terminal connections designated for freestanding shelf installation.
FET	Field Effect Transistor
Form C	A single pole, double throw, break-before-make contact set. This type of contact set with front, heel, and back contacts was used in the original DM Style code transmitter. The “switch pair” of the DM SSCT is the solid state equivalent of a Form C contact set.
FRA	Federal Railroad Administration
in.	Inch
LED	Light-emitting diode
MOV	Metal Oxide Varistor (protection device for electronic components)
PCB	Printed Circuit Board
RMS	Root-Mean-Square (method of expressing AC voltage rating)
SSCT	Solid State Code Transmitter
TranZorb®	Registered Trademark of a transient voltage suppression device, manufactured by General Semiconductor, Inc.
Triac	Solid state semiconductor switch
US&S	Union Switch and Signal Inc.
V	Volt
WARNING	Warning statements indicate conditions that could cause physical harm, serious injury, or loss of life.

1.3 Safety

Read and thoroughly understand this manual before attempting any of the procedures listed. Pay particular attention to the WARNING and CAUTION statements that appear throughout this manual. Always observe standard precautions familiar to trained electrical technicians. Always adhere to all safety regulations stipulated by the railroad.

1.4 Part Numbers

Table 1-2 provides a list of the part numbers for the Shelf-Mounted SSCT units and cross references part numbers for the old DM style electromechanical and SSCT units. In addition, the table lists the code rate, operating voltage, and the contact configuration of the relays.

Table 1-2 - Part Number Cross Reference

Shelf-Mounted SSCT Part Number	Replaced Old DM Style Electro-mechanical Unit Part Number	Replaced DM Style SSCT Part Number	Code Rate (cpm)	Operating Voltage (VDC)	Contact Configuration
N40701601	N242040, N242041, N242046, N276412	N32001507	72	8 – 16	4 Front/4 Back Low Voltage
N40701602	N242042, N242043	N32001504	72	8 – 16	4 Front/4 Back High Voltage
N40701603	N242045	N/A	72	8 – 16	2 Front/2 Back Low Voltage #1, #2 2 Front/2 Back High Voltage #3, #4
N40701604	N221553, N221558	N32001506	123	8 – 16	4 Front/4 Back Low Voltage
N40701605	N221554, N221556	N32001503	123	8 – 16	4 Front/4 Back High Voltage
N40701606	N221560	N/A	123	8 – 16	2 Front/2 Back Low Voltage #1, #2 2 Front/2 Back High Voltage #3, #4
N40701607	N221552, N221559	N32001505	184	8 – 16	4 Front/4 Back Low Voltage
N40701608	N221555, N221557	N32001502	184	8 – 16	4 Front/4 Back High Volttage
N40701609	N221561	N32001501	184	8 – 16	2 Front/2 Back Low Voltage #1, #2 2 Front/2 Back High Voltage #3, #4

2 Specifications

Table 2-1 lists the general specifications for the shelf-mounted SSCT. Refer to the label of your particular unit for the specifications unique to that configuration.

CAUTION

Observe voltage and current requirements listed on the label of the DM SSCT. **Do not exceed maximum voltages.** If these restrictions are not followed, damage to equipment could result.

Table 2-1 - General Specifications

Parameter	Specification
Power Supply Input Voltage	8 to 16 VDC. Reverse voltage protected operating range.
Current Consumption	100mA maximum
Output Switch Rating	Low Voltage: AC/DC 2.5 A, 32 VDC maximum or 22 VAC rms maximum, “on” resistance is 0.5 ohms (short circuit protected).
	High Voltage: AC only, 4.0 A, 150 VAC rms maximum, AC only. External 6A fuse required for short circuit protection. Voltage drop across the switch is 1.25 VAC rms, independent of current.
Outputs	4 pairs of front-heel-back (Form C)
Operating Temperature	-40° to +70° C (non-condensing at 0 to 95% humidity)
Dielectric Strength	2000 VAC rms between all external isolated connections and case except across open switches which are limited by TranZorb or metal oxide varistors (MOV) protection.
	Maximum voltage is determined by a TranZorb to protect DC switches from excessive voltage spikes when operating code following relays; for the AC version, a 150 VAC rms MOV is similarly used anticipating 120VAC rms as the source voltage.

2.1 Identification

The identification label is mounted on the front of the unit. This label provides important information about the shelf-mounted SSCT. A typical label is shown in Figure 2-1.

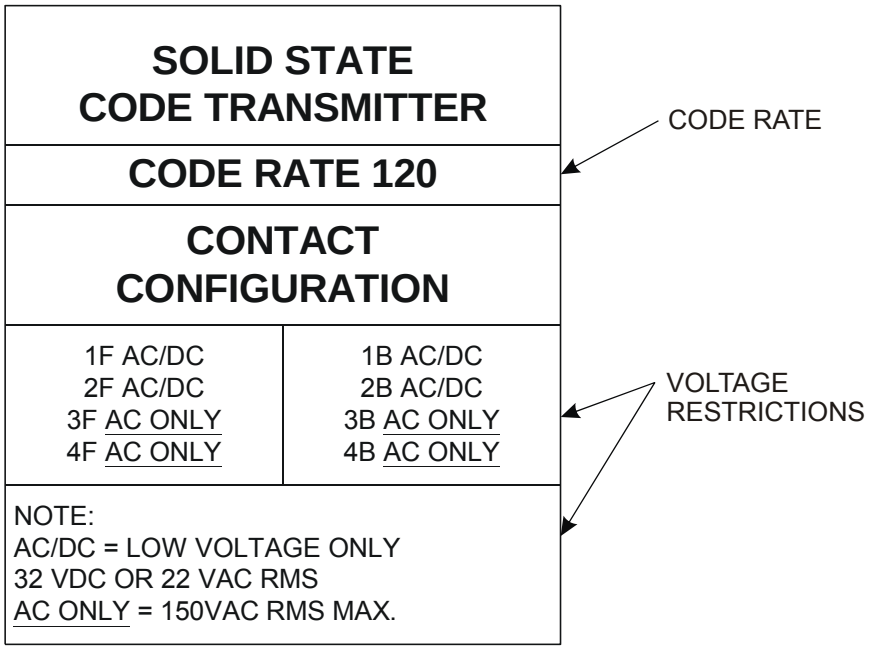

Figure 2-1 - Shelf-Mounted SSCT Typical Identification Label

3 Functional Description

3.1 Functional Overview

Referring to Figure 3-1, the SSCT contains four pairs of output switches. Each switch pair has three connections - front (F), back (B), and heel (H). The number associated with each connection denotes the switch pair. For example, "1F" is the front connection and "1B" is the back connection of the switch pair "1." The terminals are mounted on the top of the relay and are shown in Figure 3-2.

The function of the SSCT is to switch the heel (H) connection between the front (F) and back (B) connections at a specific rate. The four back switches are actuated simultaneously by the front output controller. The four back switches are actuated simultaneously by the back output controller.

NOTE

Even though switching is accomplished by solid state components, the familiar nomenclature of relays - "front, " "back," and "heel" - is used. A solid state "switch pair" performs the same function as an electromechanical contact set.

Since the shelf-mounted SSCT is a solid state replacement for an electromechanical unit, its circuits are designed to emulate the toggling, or pendulum action, of relays. With a code transmitter relay, an electromagnet attracts and then releases an armature - the resulting motion alternately closes and opens an opposing pair of contacts. As with a pendulum, there is a neutral position where neither set of contacts is closed, consequently, the "on" time for each (front and back) circuit is less than 50% of one full on-off cycle. See Table 3-1 for timing parameters.

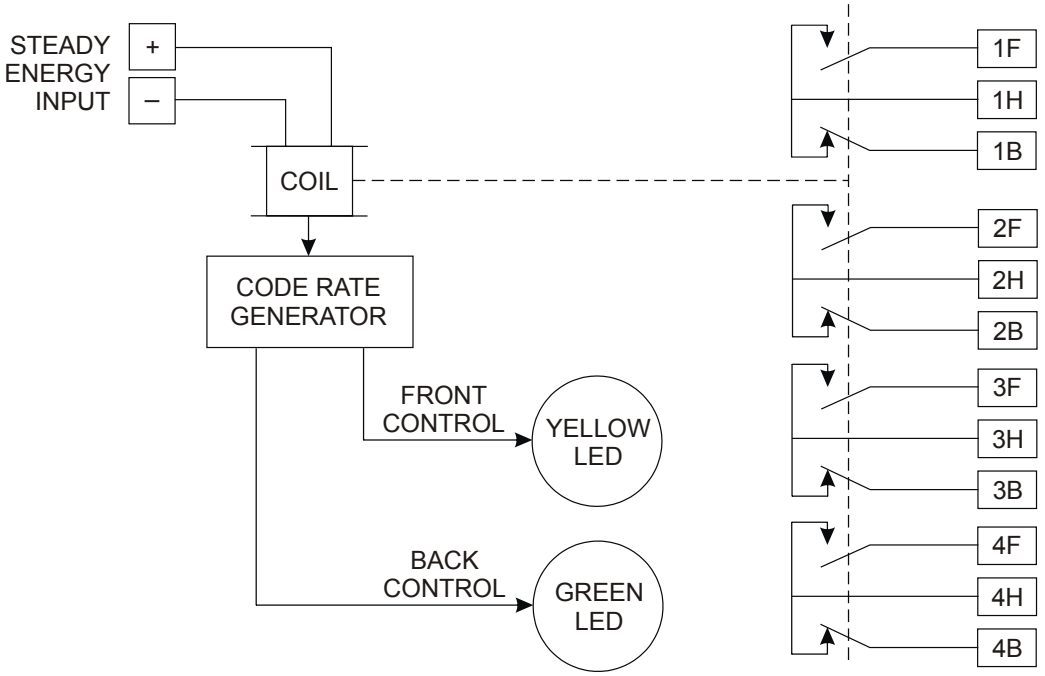

Figure 3-1 - DM SSCT Functional Block Diagram

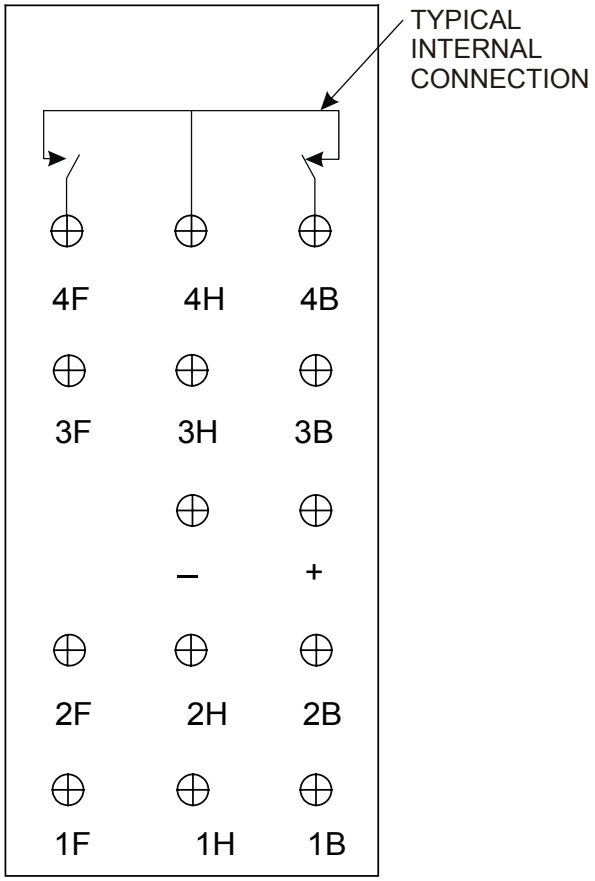

Figure 3-2 - Relay Terminals and Internal Wiring

Table 3-1 - Timing Parameters

Nominal Code Rate (cpm)	On Time (Percentage)	On Time (Seconds)
75	45 - 47	0.4120 - 0.357
120	44 - 46	0.236 - 0.205
180	42 - 44	0.151 - 0.130

3.2 Detailed Functional Description

Internal electronics are divided between two printed circuit boards (PCBs) - a timing PCB and an output PCB. The timing PCB generates timing signals used to actuate the switching circuits at the designated rate. The output PCB contains the switching circuitry.

On the timing PCB, the primary timing signal is generated by a sine wave oscillator. This timing signal feeds a pair of comparators. The non-inverted square wave output of one of the comparators is used as a timing signal for front switch control. This inverted square wave output of the other comparator is used for back switch control. There is a time delay between the instant that the front switches off and the back switches turn on (and conversely when the backs turn off and the fronts on). This delay prevents the two “on” periods from overlapping and simulates a break before make contact operation.

On the output PCB, the comparators’ timing signals are optically coupled to solid state switching devices. These switching devices are of two different types. The first type uses field effect transistors (FETs) for switching low voltage AC or DC signals. The second type uses triacs for switching higher AC voltages. The low voltage device is rated at 32 VDC rms or 22 VAC rms at 2.5 amp maximum. The high level switching device is rated at 150 VAC rms and 4.0 amp maximum. Refer to the product’s label for each switching path’s configuration and corresponding power restriction.

4 Installation

4.1 Installation Overview

The shelf-mounted style code transmitters are freestanding units designed for installation on a shelf or on another flat surface. The shelf-mounted SSCT will replace an electromechanical DM style or a solid state DM style code transmitter. The units connect in the same manner as the replaced model.

The overall dimensions of the shelf-mounted units and their mounting holes are shown in Figure 4-1.

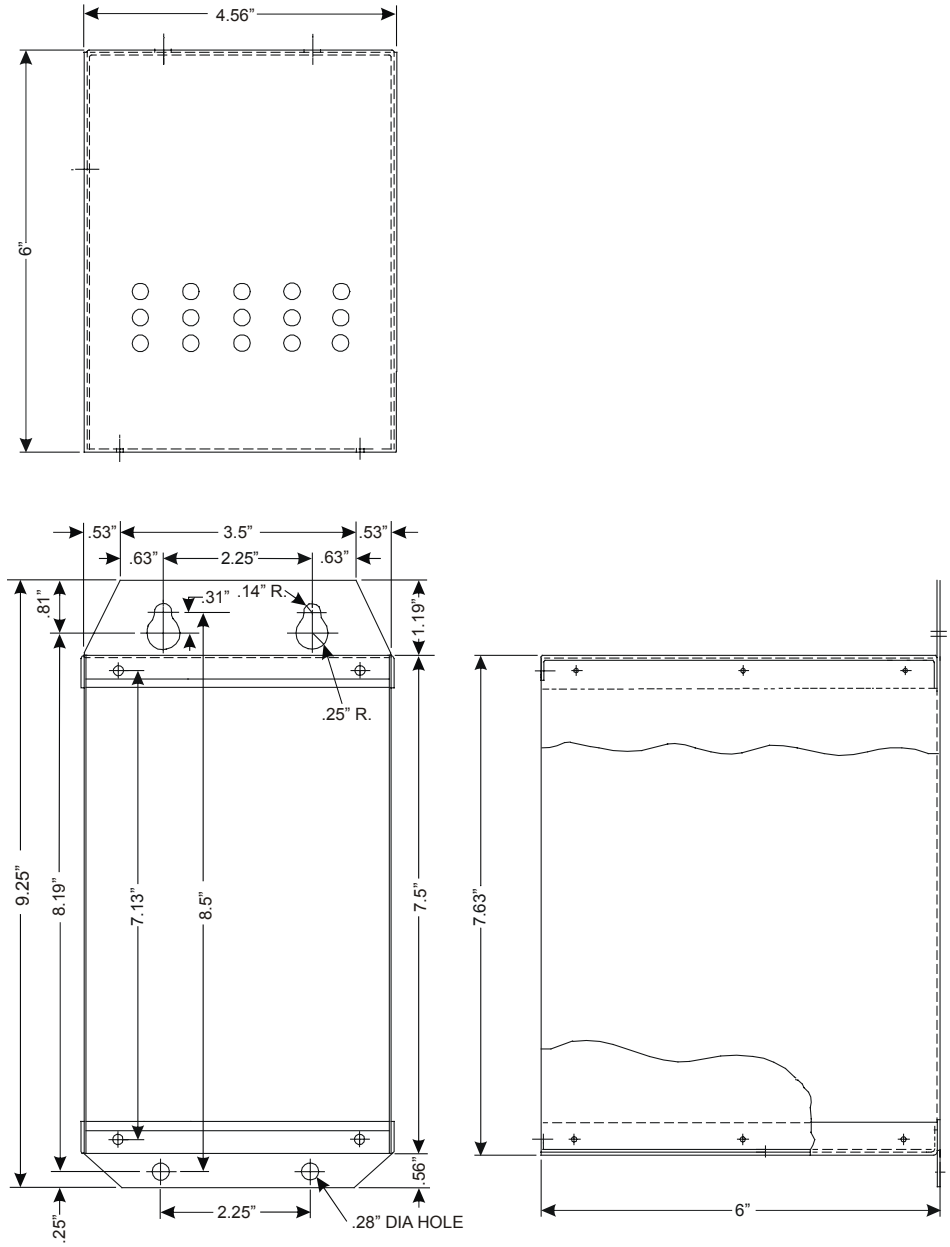

Figure 4-1 - Overall Dimensions and Mounting Holes for the Shelf Mounted SSCT

4.2 Installation Procedure

The following procedure is for the replacement of an old DM style electromechanical or DM style solid state code transmitter relay with the shelf-mounted SSCT relay.

WARNING

Disable all power from the unit being replaced and from any nearby circuits. Failure to do so could result in physical harm, serious injury or loss of life.

CAUTION

Observe voltage and current requirements listed on the label of the SSCT. Do not exceed maximum voltages. If these restrictions are not followed, damage to equipment could result.

1. Observe all warning and caution statements listed throughout this manual. Follow the safety policies established for your work site regarding the installation of electronic equipment.
2. To prevent wiring mistakes when installing the unit, note the connections and arrangement of the wiring to the old unit.
3. Detach the wire leads and remove the old unit.
4. Place the unit in position making sure that at least one set of indicating LEDs is easily visible (see Figure 1-1).
5. Refer to the locations of the tags identifying the terminals of the SSCT. Do not remove the terminal identifying tags from the unit.
6. Connect the wires to the AAR terminals of the unit in the same manner as they were connected to the old unit. Verify that the wiring is in accordance with the schematic diagrams and wiring instructions for your application.
7. Complete the installation checklist, Figure 4-2.
8. Make a copy of the completed check list and file for future reference.
9. Verify the unit is installed properly and is operational (Section 4.3).

Installer _____ **Date** _____

Installation Location _____

SSCT Part No. _____ **Code Rate** _____

Serial No. _____

	Yes	No
Voltage restrictions on the label have been followed.	❒	❒
Replacement unit is connected in same manner as the unit being replaced.	❒	❒
Wiring is in accordance with applicable schematic diagrams and wiring instructions.	❒	❒
Terminal identifying tags of the new unit have not been removed.	❒	❒
Insulating sleeve and insulating nut installed on all AAR terminals, if required.	❒	❒

Figure 4-2 - Installation Check List

4.3 Operational Verification Test

This test is performed to verify proper installation before a unit or system is placed into regular service. To properly verify the operation of the SSCT, test the unit as follows:

1. Make sure that all the requirements of Section 4, Installation, have been met.
2. Restore power to the system of which the shelf-mount SSCT is part.
3. Verify that the unit is functioning properly in an alternating manner with similar on and off periods. If a problem is suspected, check the connections, and correct if necessary. If a problem is still suspected, see Section 6.
4. Verify that the system - of which the shelf-mounted SSCT is part - is functioning correctly. If a problem is suspected with the SSCT, see Section 6.

5 Operation/Maintenance

5.1 Operation

The SSCT is a component that, when powered, operates continuously without intervention. There are no operating procedures for this unit.

5.2 Field Maintenance

5.2.1 Schedule

Since there are no Federal Railroad Administration (FRA) requirements for periodic inspections of solid state code transmitters, periodic verification of the shelf-mounted SSCT operation is at the customer's discretion.

5.2.2 Preventive Maintenance

WARNING

Before beginning this procedure, make sure that all power is disabled from the unit from any nearby circuits. Failure to do so could result in physical harm, serious injury, or loss of life.

Clean any dust and dirt from the top assembly, AAR terminals, and attaching hardware with a clean, dry cloth.

5.2.3 Calibration

The shelf-mounted SSCT is calibrated at the factory. There are no calibration procedures that can be performed by the customer.

5.2.4 Adjustment

There are no adjustment procedures for the SSCT.

5.3 Shop Maintenance

Because the shelf-mounted SSCT does not contain any serviceable parts, shop maintenance is limited to a performance test to determine if the unit is functioning correctly. Specifically, the test will indicate if the code rate of the SSCT is within tolerance.

5.3.1 Equipment Required

- 12 VDC power supply
- AC power supply with 15 VAC output

- Code follower relay
- Code rate meter
- Diode bridge rectifier
- 2amp, 15VAC fuse

5.3.2 Test Procedure

WARNING

The testing equipment produces potentially hazardous electrical power. Use caution when testing. Failure to do so could result in physical harm, serious injury, or loss of life.

CAUTION

Observe voltage and current requirements listed on the label of the SSCT. Do not exceed maximum voltages. If these restrictions are not followed, damage to equipment could result.

CAUTION

Do not attempt to electrically test the SSCT in any other manner than that depicted by the test circuit of Figure 5-1. If any other testing method is used, damage to the equipment could result. Construct the test circuit as shown in Figure 5-1.

1. Connect the SSCT per Figure 5-1.
2. Set the code rate meter to the code rate of the SSCT being tested. Refer to the instruction manual for the code rate meter for operational details.
3. Check that the code rate meter indicates that the SSCT is within tolerance.
4. If the SSCT is within tolerance, then the unit is functioning correctly. If the SSCT is not within tolerance, the unit is malfunctioning and should be returned to US&S for service.

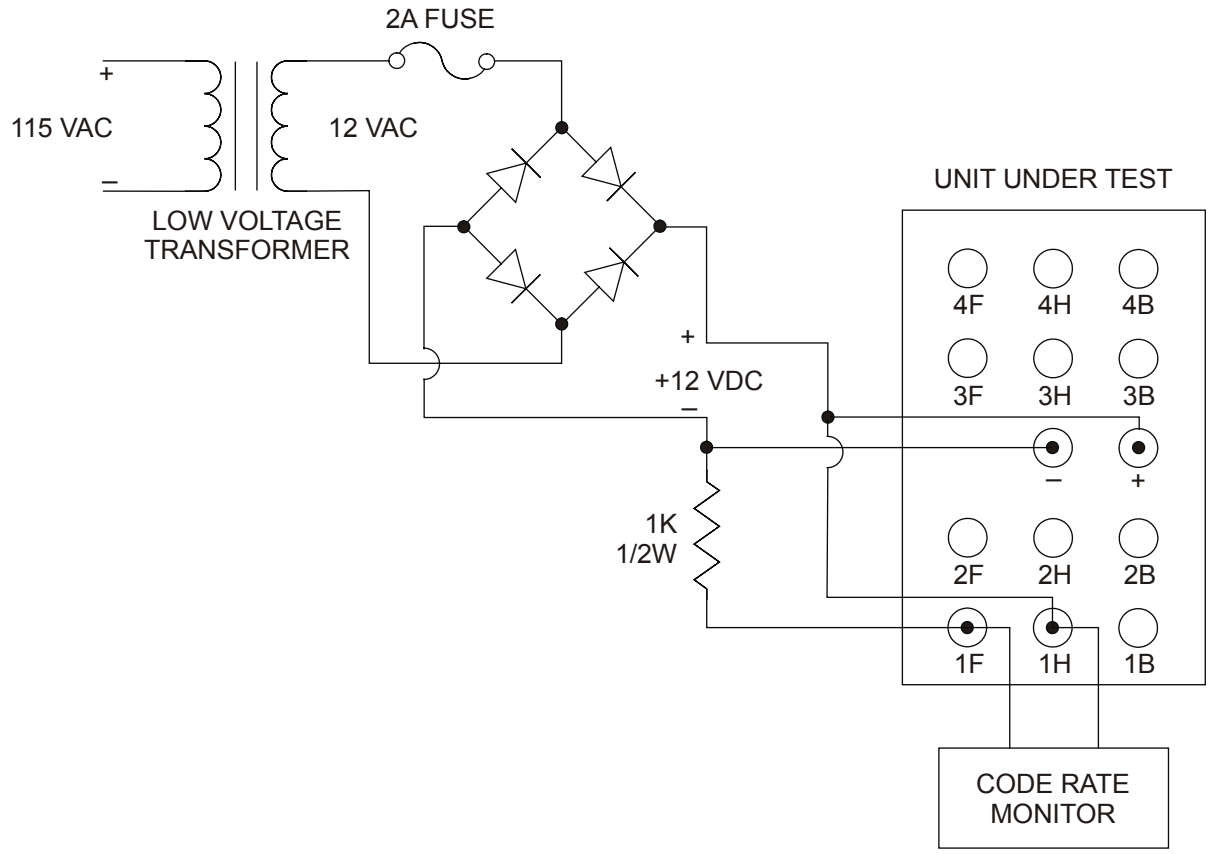

Figure 5-1 - DM SSCT Test Circuit

6 Troubleshooting

Table 6-1 lists various symptoms, their possible cause, and the recommended corrective action to take to eliminate the symptom.

Table 6-1 - SSCT Troubleshooting

Symptom	Possible Cause	Corrective Action	Section Reference
Not coding	Power input not present	Check that power is applied at the unit.	
		Check the connections.	
	SSCT internal failure	Replace the SSCT. Perform a shop test on the removed unit.	5.3
Symptom does not produce expected code rate	SSCT internal failure	Replace the SSCT. Perform a shop test on the removed unit.	5.3
	Failure external to SSCT	Perform a system test.	

6.1 Repairing/Replacing Components

There are no repairable or replaceable components in the SSCT. Return a malfunctioning unit to US&S for service. Call the US&S Rail Team (Section 7) for assistance.

7 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 project. Contact the RAIL Team at 1-800-652-7276. Or by e-mail at railteam@switch .com.