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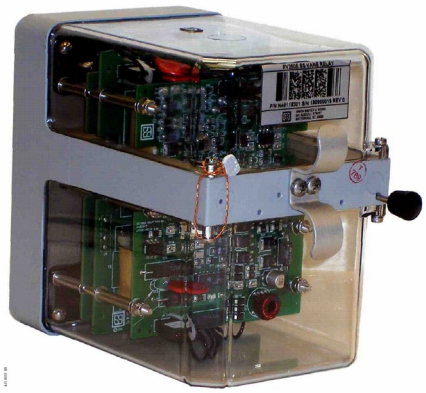
1000 Technology Drive, Pittsburgh, PA 15219
645 Russell Street, Batesburg, SC 29006

PV-250E
Electronic Vane Relay

STS USA Part Number
N40118301



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

Hitachi Rail STS

Proprietary Notice

Important Notice

STS USA 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 an STS USA local sales representative in the event of any irregularities with our product.

STS USA expressly disclaims 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 STS USA spare parts are used as replacements.

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Revision History

REV.	DATE	NATURE OF REVISION
1	August 2010	Initial release
2	March 2019	Hitachi Rail STS Branding

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1. GENERAL INFORMATION

1.1. Description

This manual covers the STS USA Electronic Vane Relay (EVR); Part Number N40118301. The EVR is shown in Figure 1-1.

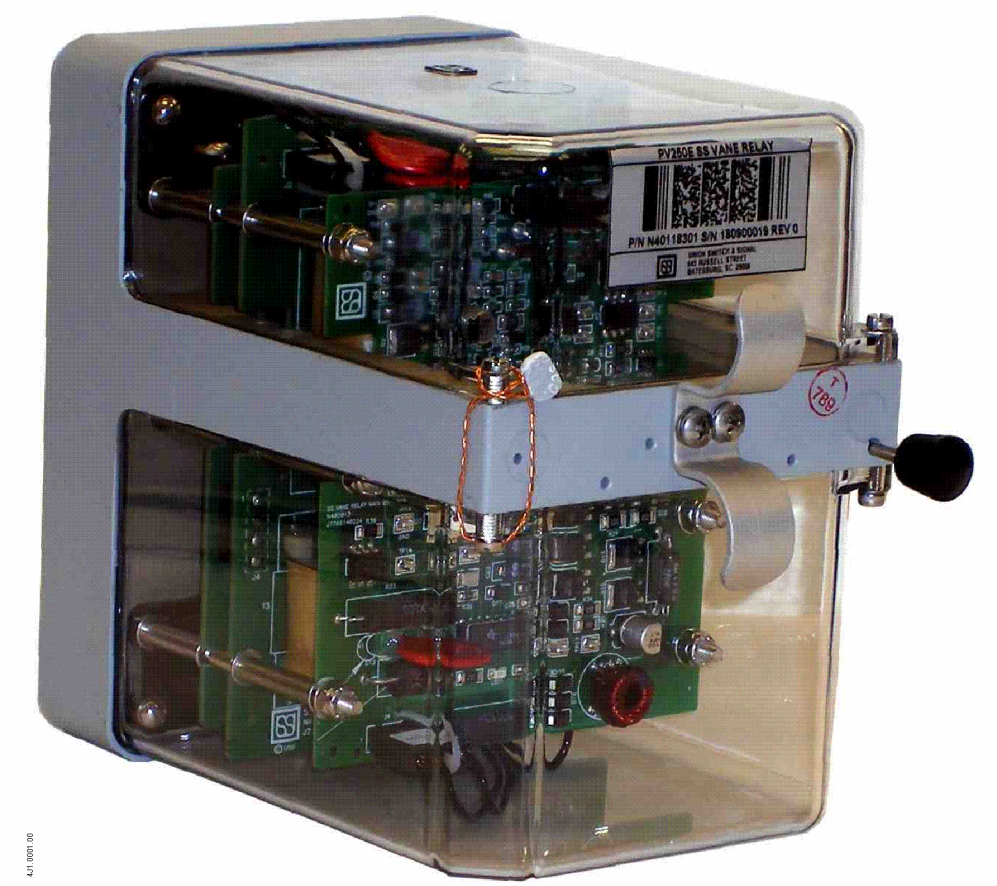

Figure 1-1. Electronic Vane Relay

1.2. Mechanical Vane Relay Replacement

The electronic vane relay (EVR) replaces the STS USA electromechanical vane relays (EMVR, PV-250).

The EVR requires slightly less local input power than the EMVR and the power consumption of the EVR is significantly less. The EVR can replace the EMVR without someone having to readjust the track circuit.

1.3. Operation

The EVR has no mechanical contacts. The EVR produces a DC output suitable for controlling multiple repeater relays or to be used as an input to a Microlok unit. The DC output is the safety equivalent of a double break circuit using two front contacts.

A green LED illuminates when the DC output is on. This is the functional equivalent of a mechanical relay being energized. The DC output is derived from the power extracted from the local input power and the control current and its phase relationship to the local input voltage.

A yellow LED illuminates when the control input is marginal or if the track circuit is occupied.

When the control input is between five and six volts, the green LED will be illuminated and the yellow LED will be dark. If both LEDs are illuminated, the control input is marginal (approximately 3.3 volts) and the track circuit should be examined.

1.4. Specifications

Specifications for the Electronic Vane Relay are given in Table 1-1.

Table 1-1. Relay Specifications

Parameter	Value
Weight	4.9 pounds 5.5 pounds (N40118301)
Operating Temperature Range	-40°C to +70°C
Vibration	Class A (4.2 gs peak)
Isolation Voltage All points	2000 V rms
Control Input Impedance	62 ohms
Local Power and VA	Power = 4.85 watts; 6.33 VA
Local Input Impedance	2090 ohms @40°C
Operating Frequency	60 Hz
Pick-Up Current	Nominal 0.05 amps +/- 10% over temperature range
Phase angle range (local to control)	-20° to +20°
DC Output Voltage	Nominal 14.5 VDC into 500 ohms @ local = 115 Vrms (See below)
Pick-Up Time	40 milliseconds
Drop-Away Time	150 milliseconds
Non-Vital Simulated Relay Contact	ON Resistance: < 1.0 ohm Switching range up to 2.5 amperes @ 30 volts AC or DC. Short circuit protected.

2. INSTALLATION

2.1. General

Relays plug directly into a mounting base that is secured to a rack. The only installation instructions required are for the mounting base.

2.2. Mounting Base

The mounting base can be secured directly to the rack using the hardware furnished. All wiring terminates at the rear of the mounting base to solderless terminals (contact receptacles).

2.3. Relay Indexing

Relays are factory equipped with indexing pins to prevent insertion of an incorrect relay into a mounting base. Each relay is accompanied by an indexing plate which is applied to the mounting base at the time of initial installation. A typical plug-in relay with indexing pins and base with corresponding indexing plate is shown in Figure 2-1.

The following data defines the indexing that has been established for relays covered by this manual.

1. The index code always consists of four figures (such as 0001, 0002, or 0101), and is used for both the relay and the indexing plate on the mounting base.

2. The index code for each mounting base is determined by the placement of the holes in the numbered vertical rows of the large white nylon indexing plate which is affixed to the front of the mounting base. This indexing plate should not be removed from the mounting base, unless it is damaged or the indexing is to be purposely changed to accommodate a relay of a different part number. Discard the indexing plate which comes in a bag tied to the handle of all new relays unless it is needed for replacement or damaged indexing plate or for application to a new mounting base.

WARNING

Never drill new holes in a base indexing plate which will permit application of relays with different part numbers or change indexing pins on the back of a relay unless it is being converted to a new part number. Otherwise, a hazard will be created which may compromise safety circuit functions.

2.4. Receptacle Contact Springs

2.4.1. Old Style Base Only

The N376442 mounting base is normally equipped with the required quantity of solderless receptacle contact springs (STS USA part number J680165). The base accommodates one or two #14 or #16 wires. It can, however, be equipped with receptacle contact springs for one or two #10 or #12 wires (STS USA part number J680181), or for one or two #18 or #20 wires (STS USA part number J680179). Make certain which type of solderless receptacle contact springs accompany the mounting base before proceeding with their installation.

2.4.2. Improved One-Piece Base Only

The improved one piece mounting base with hardware includes a full complement of receptacle contact springs (STS USA part number M4511422702) to accommodate one or two #14-#16 wires, mounting fasteners, and tags. It can, however, be equipped with receptacle contact springs for one or two #10-#12 wires (STS USA part number M4511422703), or for one or two #18-#20 (STS USA part number M4511422701). Make certain which type of solderless receptacle contact springs accompany the mounting base before proceeding with their installation.

Each solderless receptacle contact springs should be inspected for physical damage before proceeding with installation.

The following is recommended when installing solderless receptacle contact springs after crimping wires:

1. Receptacle contact springs must be inserted into the base with the lock side down or lanced tab up (see Figure 2-2).

2. Make certain that the lanced tab is slightly compressed as the receptacle contact spring is inserted along the top of the cavity. The lanced tab could have been bent during handling, and therefore would not provide the required contact pressure after the relay is inserted. If the lanced tab does not touch, pull it up slightly using fingers or a suitable tool.

3. After insertion, pull firmly on the wire to make certain the receptacle contact spring is locked in the cavity.

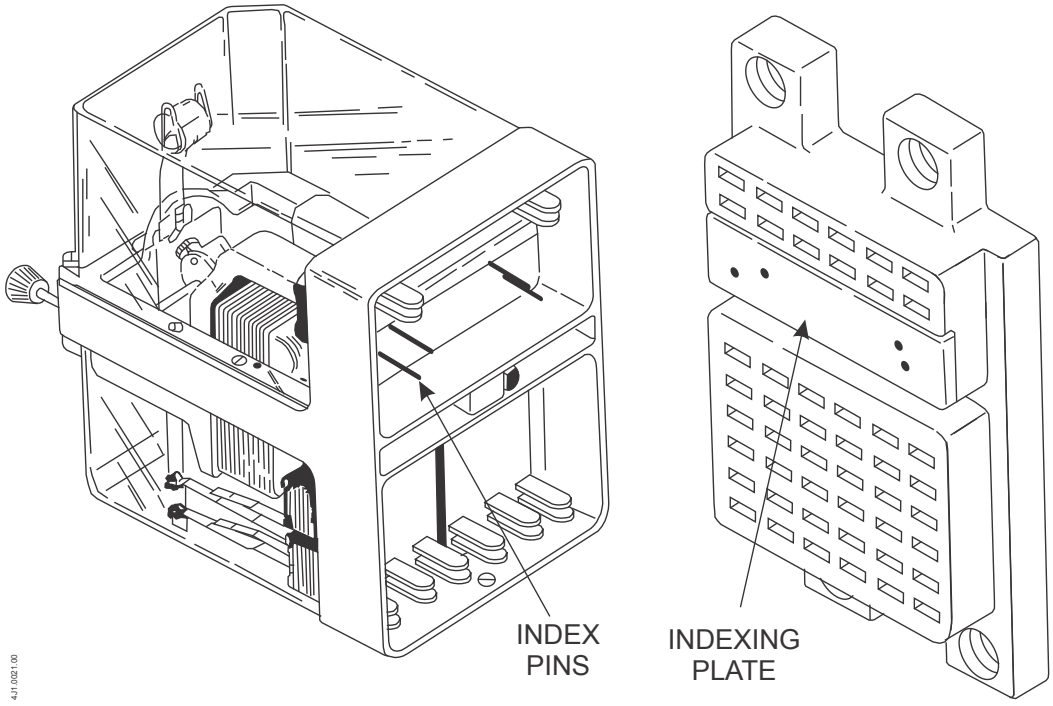

Figure 2-1. Typical Plug-in Relay and Mounting Base

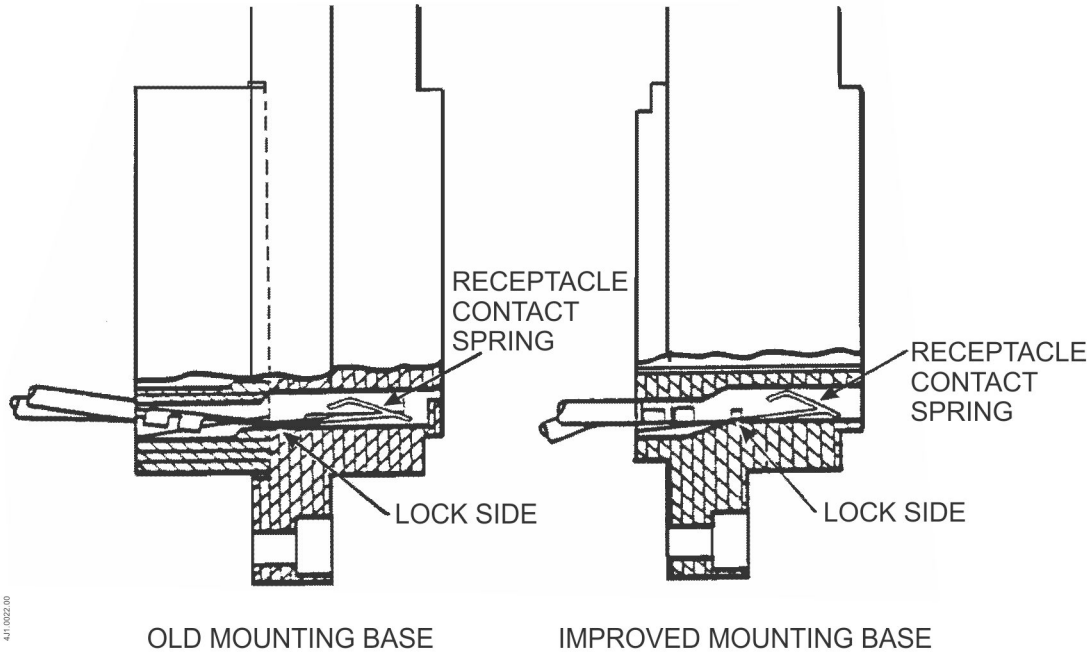

Figure 2-2. Receptacle Contact Springs Installed

2.4.3. Installing Wires in Receptacle Contact Springs

Use the following procedure to ensure a good electrical and mechanical connection between the conductor wire and the receptacle contact spring. The chart below identifies the correct crimping tool to be used when installing wires in the receptacle contact spring.

Crimping Tool	Wire Size	Old Style Receptacle Contact Spring	Improved Base Receptacle Contact Spring
J397138	#10/#12 AWG	J680181	M4511422703
J397139	#14/#16 AWG	J680165 (Standard)	M4511422702
J397188	#18/#20 AWG	J680179	M4511422701

1. Strip 3/16 in. (0.187 in. or 0.47 cm.) of insulation from the end of the wire.

2. Place the receptacle contact spring into the jaws of the proper crimping tool. When using only one terminal, of any wire size, use the shortest terminal.

3. Partially close the crimping tool jaws against the receptacle contact spring to hold it in place. (Do not crush the receptacle contact spring barrel at this time.)

4. Insert the stripped end of wire all the way into the receptacle contact spring barrel. Squeeze the tool handles until crimping is completed and the jaws release. When using both terminals, it is more convenient to attach the first wire to the longest terminal.

5. Remove the crimped receptacle contact spring from the tool and inspect the connection. Make certain that the wire is flush with the crimped barrel, and that there are no loose strands of wire.

2.5. Relay Insertion

Orient the relay to the mounting base with the name plate right side up; then plug the relay into the base. The relay should be pushed firmly against the mounting base while pressing the latch rod. After the relay is completely seated in the base, release the latch rod and pull on the handle to ensure that the relay has locked in place.

3. APPLICATION

The EVR is intended for single rail or double rail track circuits for use with DC propulsion power. A series tuned filter in the control input is used to eliminate propulsion harmonics from interfering with normal operation.

3.1. Single Rail Track Circuit

A typical single rail track circuit is shown in Figure 3-1. T2 has a turn ratio of 5:1 and is configured to step up the rail voltage by a factor of 5:1. When used in this configuration, the circuit is adjusted by setting the output of T1 to a voltage appropriate with length of the track circuit. Table 3-1can be used as a guide when setting up the track circuit.

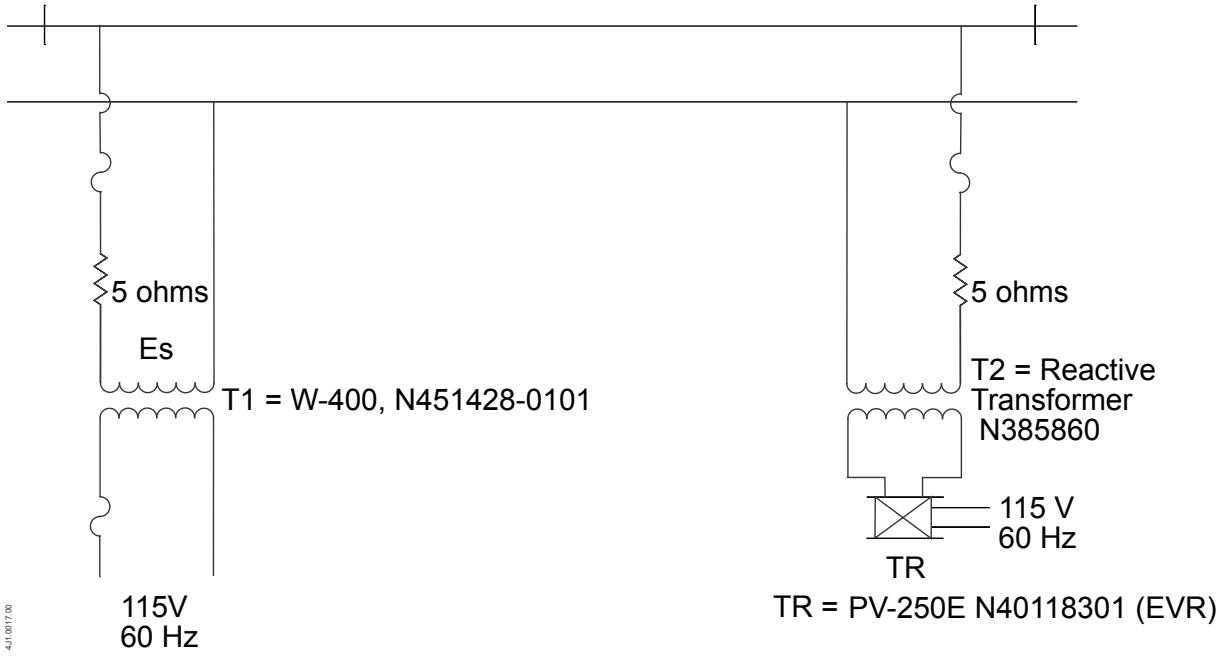

Figure 3-1. 60 Hz Single Rail Track Circuit

Table 3-1. Track Circuit Adjustment Table

Track Circuit Length		Es Volts	Relay Current at dry Ballast (amps)
Feet	Meters		
1500	457	17.3	0.21
1400	427	16.5	0.20
1300	396	15.6	0.19
1200	366	14.8	0.18
1100	335	14.0	0.17
1000	305	13.2	0.16
900	275	12.4	0.15
800	244	11.6	0.14
700	213	10.8	0.13
600	183	10.1	0.12
500	152	9.3	0.11
400	122	8.6	0.10
300	91	7.8	0.10
200	61	7.1	0.09
100	30	6.4	0.08
≤ 50	≤ 15	6.0	0.07

3.2. Double Rail Track Circuit

Double rail track circuits require a 0.5 ohm impedance bond at each end and typically 0.5 ohm track resistors at each end as shown in Figure 3-2. Due to the impedance bonds and rail inductance, a phase compensation network is required to be placed in series with the local input. The network consists of a 300 ohm resistor and a 2.5 mfd capacitor (part number N384957) and mounts on back of the relay base.

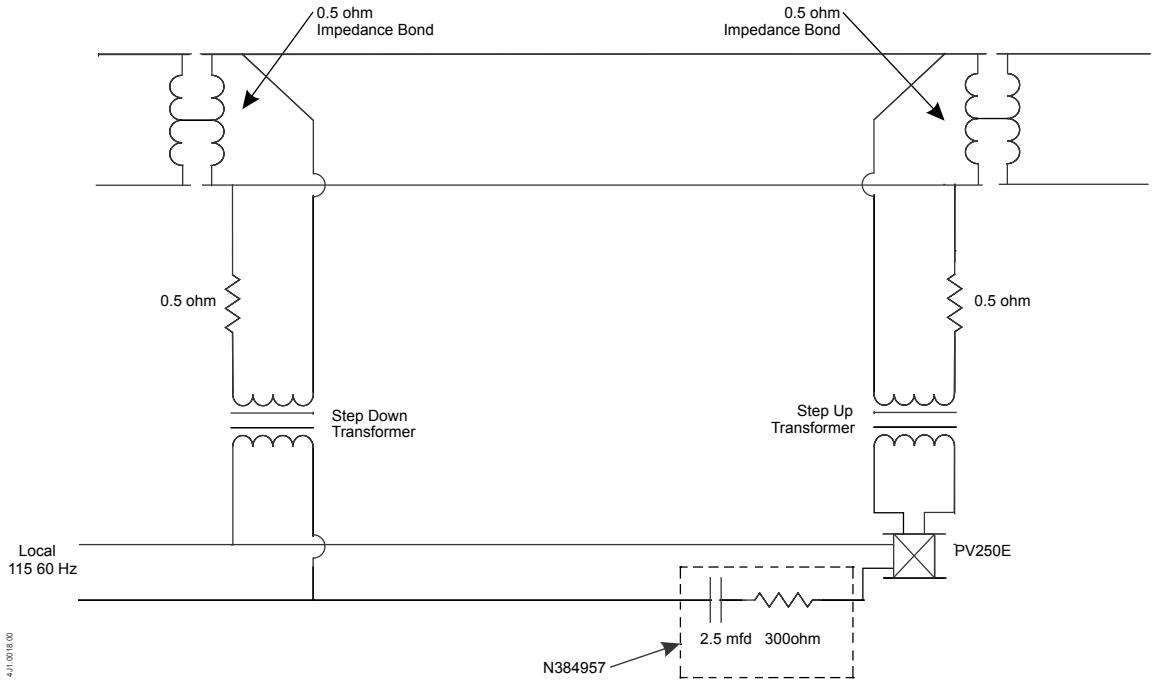

Figure 3-2. Double Rail Track Circuit in a Cab Signal Application

Double rail track circuits are also compatible with cab signal applications. When the track circuit is unoccupied, steady energy is applied to the rails. When a train enters the track circuit, ON/OFF coding is initiated at 75, 120 or 180 CPM (codes per minute). With normal progression of a train, logic responding to occupancy of the next track circuit restores steady energy to the track circuit from which the train exited. The EVR responds by producing a DC output to indicate that the track circuit is reset or no longer occupied.

If normal train progression is not followed, the track circuit needs to be reset to steady energy by a means that recognizes that coding remains, although the track circuit is unoccupied. A reset module (N34801901) serves that function. It connects to the output of the EVR and produces a steady DC output only when output of the EVR is switching ON and OFF in response to coded energy on the track. Due to bandwidth considerations inherent with a series tuned filter, it is necessary to increase the signal level so that the EVR will respond to coded energy. In the worst case at 180 cpm, minimum recommended control input should be 4.0 volts. Refer to STS-USA service manual SM 8A1.0001 for more information on the reset module.


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4. DESIGN APPLICATION CONSIDERATIONS

4.1. DC Output Characteristics and Repeater Relay Considerations

The DC output is proportional to local voltage and is influenced by the connected load, i.e., the number and coil resistance of repeater relays. Figure 4-1 illustrates these relationships. As an example, if five 1300-ohm PN-150 relays are connected as parallel repeaters, the equivalent load is 260 ohms and the resulting coil voltage is 14.1, 14.5, or 15 VDC for local voltages of 110, 115, or 120 VDC, respectively. The maximum pick-up for a 1300-ohm PN-150 relay is 10.7 VDC. The EVR will operate with no change in pick-up or drop-away over a local voltage range of 90 to 135 volts but the DC output will change proportionally to the local voltage.

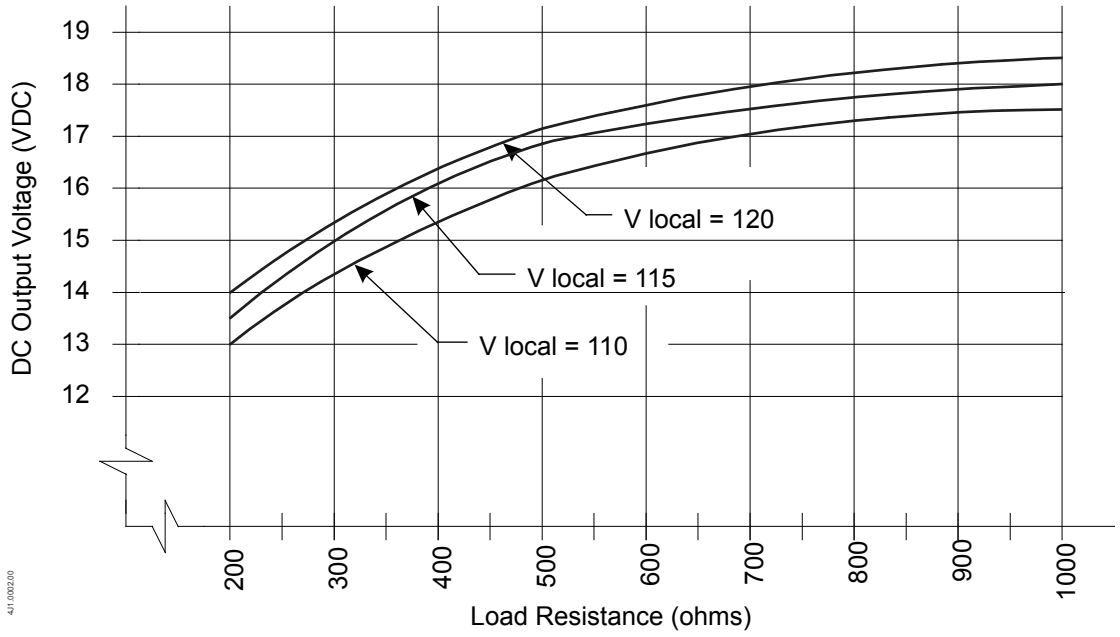

Figure 4-1. DC Output Voltage vs Load Resistance and Local Voltage

4.2. EMVR Replacement Configurations

Figure 4-2 shows a composite rear view of the mounting base when replacing a N342555-809 with a N40118301.

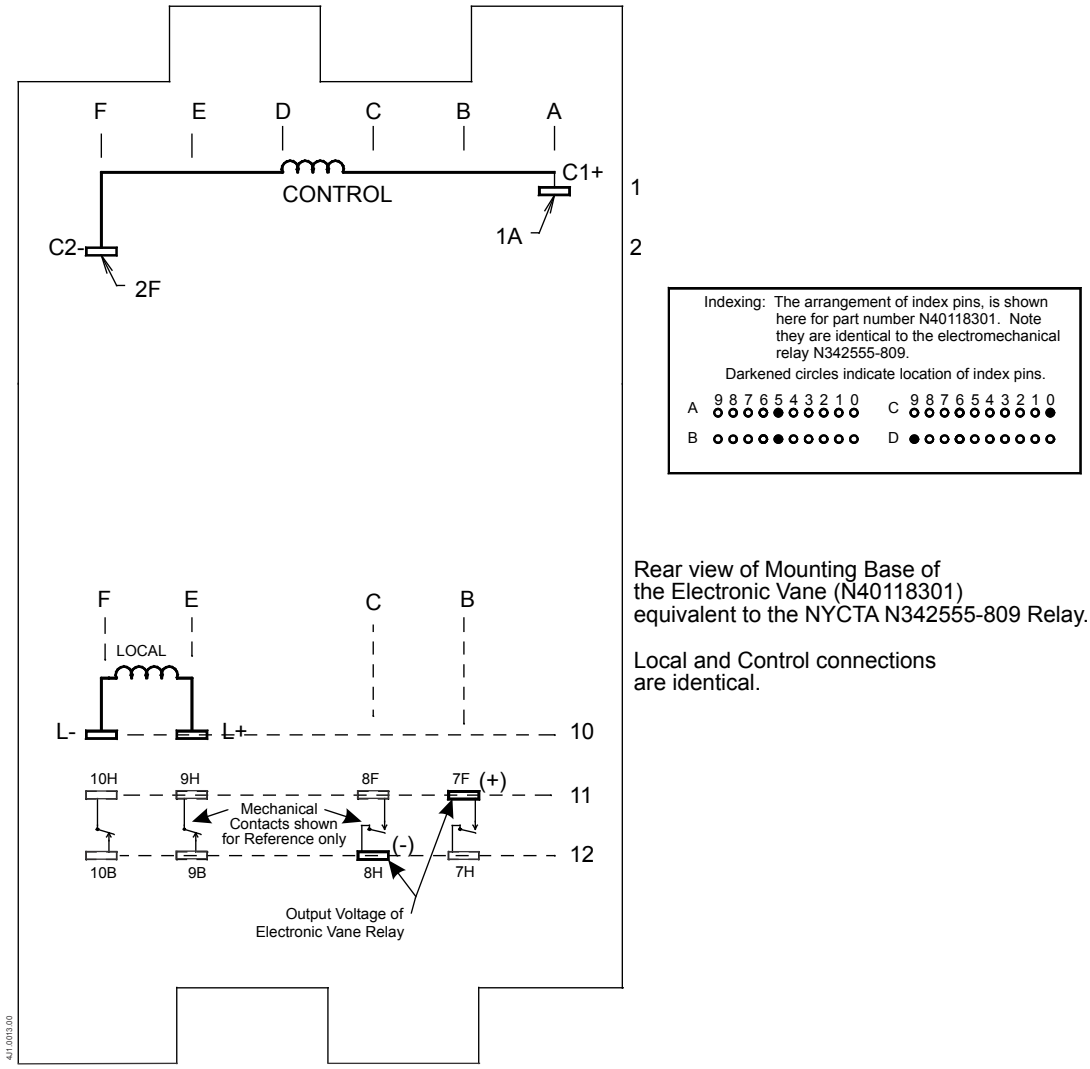

Figure 4-2. Rear View of Mounting Base and the Index Plate of EVR Equivalent for N342555809 Relay (N40118301)

Figure 4-3 and Figure 4-4 are wiring diagrams that show conversion from a mechanical vane (N342555809) to an electronic vane (N40118301) in double break and single break applications. In a single break application, an external connection to TC (Tower Common) is required. In a double break application, no wiring modification is needed.

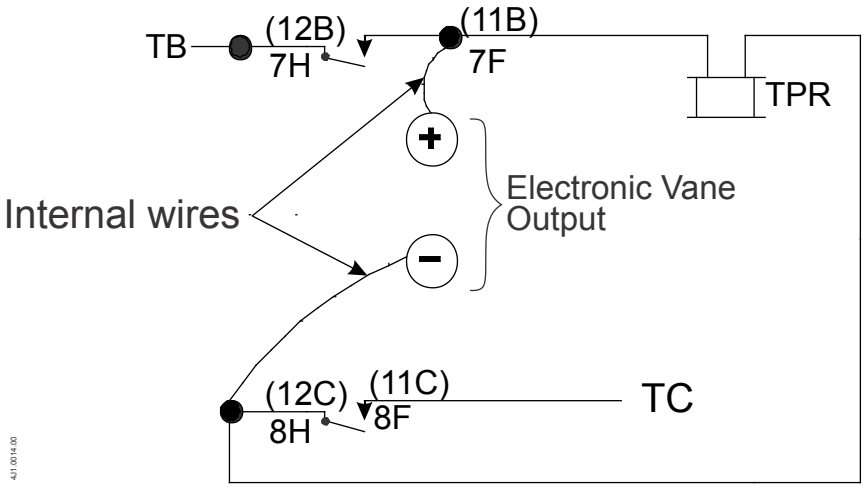

Figure 4-3. Replacement of N342555-809 with N40118301 in a double break circuit, without wiring modification

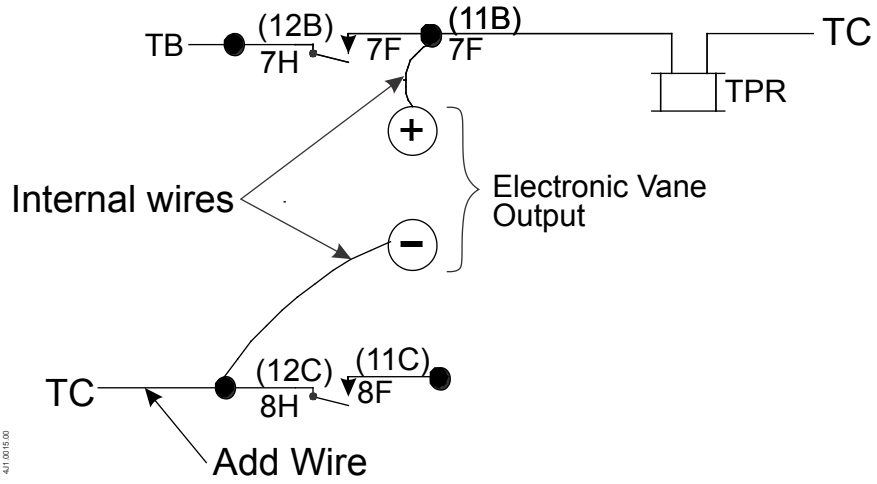

Figure 4-4. Replacement of N342555-809 with N40118301 in a Single break Circuit, with Wiring Modification


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5. CALIBRATION AND OPERATIONAL TESTING

Periodic calibration and operating testing are not required on the EVR. As a part of a shop inspection or if there is a need to verify operability of a given unit, the following procedure is recommended.

5.1. Equipment Required

- Two autotransformers
- One voltmeter
- One ammeter
- One SPST switch
- One 470 ohm, 1 Watt resistor

5.2. Test Procedure

1. Connect the EVR in the test set-up as shown in Figure 5-1.
2. Adjust T2 for 115 VAC ± 2% measured at V1.
3. Start with T1 at the minimum output. The yellow LED should be illuminated and the green LED should be dark.
4. Adjust T1 slowly until the green LED illuminates. At that point (pick-up), the DC output measured at V2, should be 13 to 18 VDC. The yellow LED should be illuminated. The corresponding pick-up current should be 50 ±5 milliamperes.
5. Increase the current until the yellow LED extinguishes. It should extinguish at 62 ± 5 milliamperes.
6. Decrease the current slowly until the green LED extinguishes with the DC output switching off. At that point (drop-away) the current should be greater than 80 % of the previously recorded pick-up current in step 4.

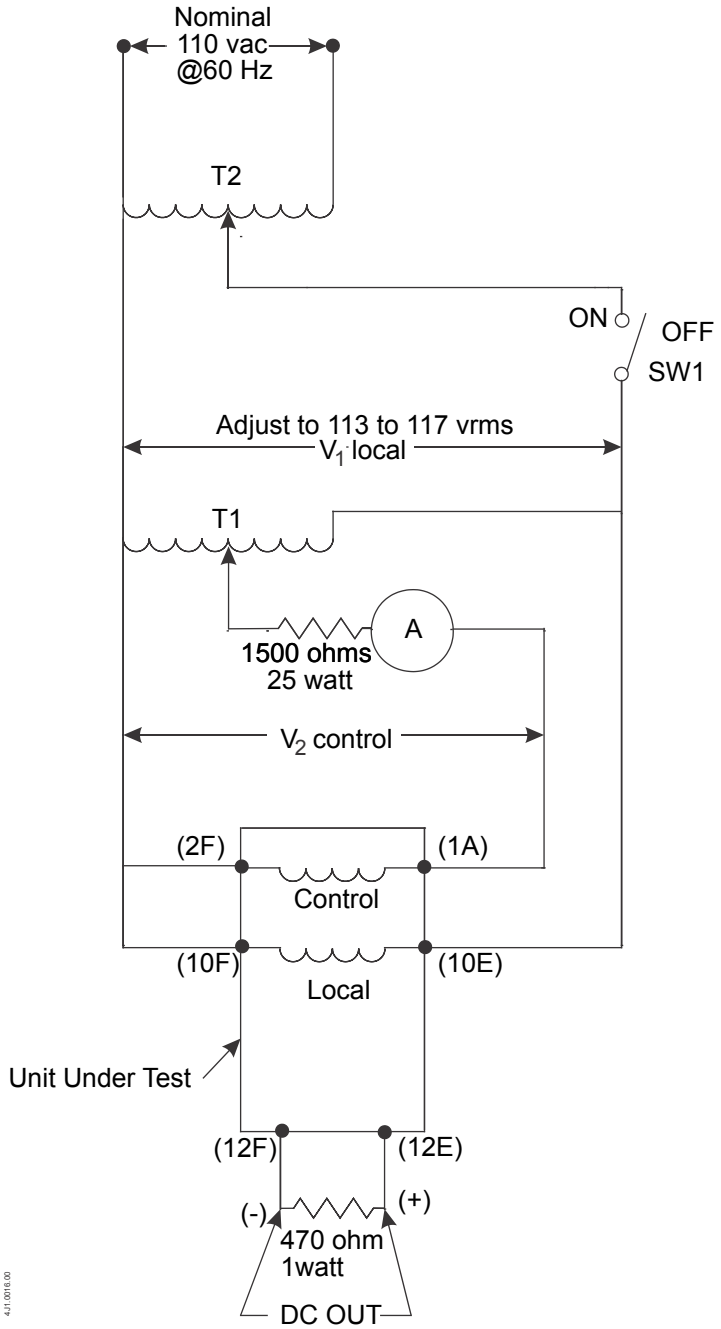

Figure 5-1. Test Set Up

6. PARTS LIST

This section contains parts lists for the Electronic Vane Relay and mounting bases.

6.1. Electronic Vane Relay

Table 6-1 lists the parts for the electronic vane relay. See Figure 6-1 for the parts location.

Table 6-1. Electronic Vane Relay (N40118301) Parts List

Item Number	Description	Part Number
1	Frame, Relay	M349197004
2	Pin, Roll, 3/32 D X 1-1/8	J487090
3	Rod, Latch	M375913
4	Nut, 1/8 HVY	M395496
5	Latch, Machined	M321728
6	Pin, Roll, SST	J048716
7	Spring, Plated	M321861
8	Terminal Block	J776599
9	Terminal Block	M40117302
10	Screw, SST, 8-32 X ½, RD	J5001320108
11	Washer, 8 SHPRF LK SS	J047714
12	Screw, 8-32X7/16 FIL HD SS	J522042
13	Spacer, Round, 1/4" OD, 1-1/4" L, 0.166" ID, SS	J7259200128
14	Screw, 8-32 X 7/16" L, Fil Head	J5072950119
15	Nameplate	M40105001
16	Washer, SST, Plate No. 8	J4751200109
17	PCB, SS Vane Relay Main	N40201301
18	PCB, SS Vane Relay Filter	N40201101
19	Spacer, Round, 6mm OD, 8 MM L, 4.3 mm ID,SS	JR112870100004
20	Nut, 8-32 Elastic Stop, SS	J048080
21	Knob, Knurled Thumb Nut	J770536
22	Handle, Pull, Aluminum	J561111
23	Screw, SST, 10-32 X 3/8 PH	J5072960129
24	Washer, SST, #10 Shak Pf	J4751210125
25	Screw, 8-32 X 4, Pan, Phillips, SS	J5072950129
26	Cable tie, 8", Nylon, Nat, 0.098" W	J703310
27	Spacer, Round, 1/4" OD, 1" L, 0.166" ID, SS	J7259200130
28	Cover, Molded Relay	J776598
29	Cover, Molded Relay	J776597
30	PCB, SS Vane Relay XMFR	N40201201
31	Wire Seal, #22 AWG, 2 PLY	A043013
32	Parts bag	N3497115509
33	Seal, Security, Gray	J079351
34	Gasket, Rubber	J047081
35	Cable, J1	N40117204
36	Cable, J2, J3, J4	N40117205

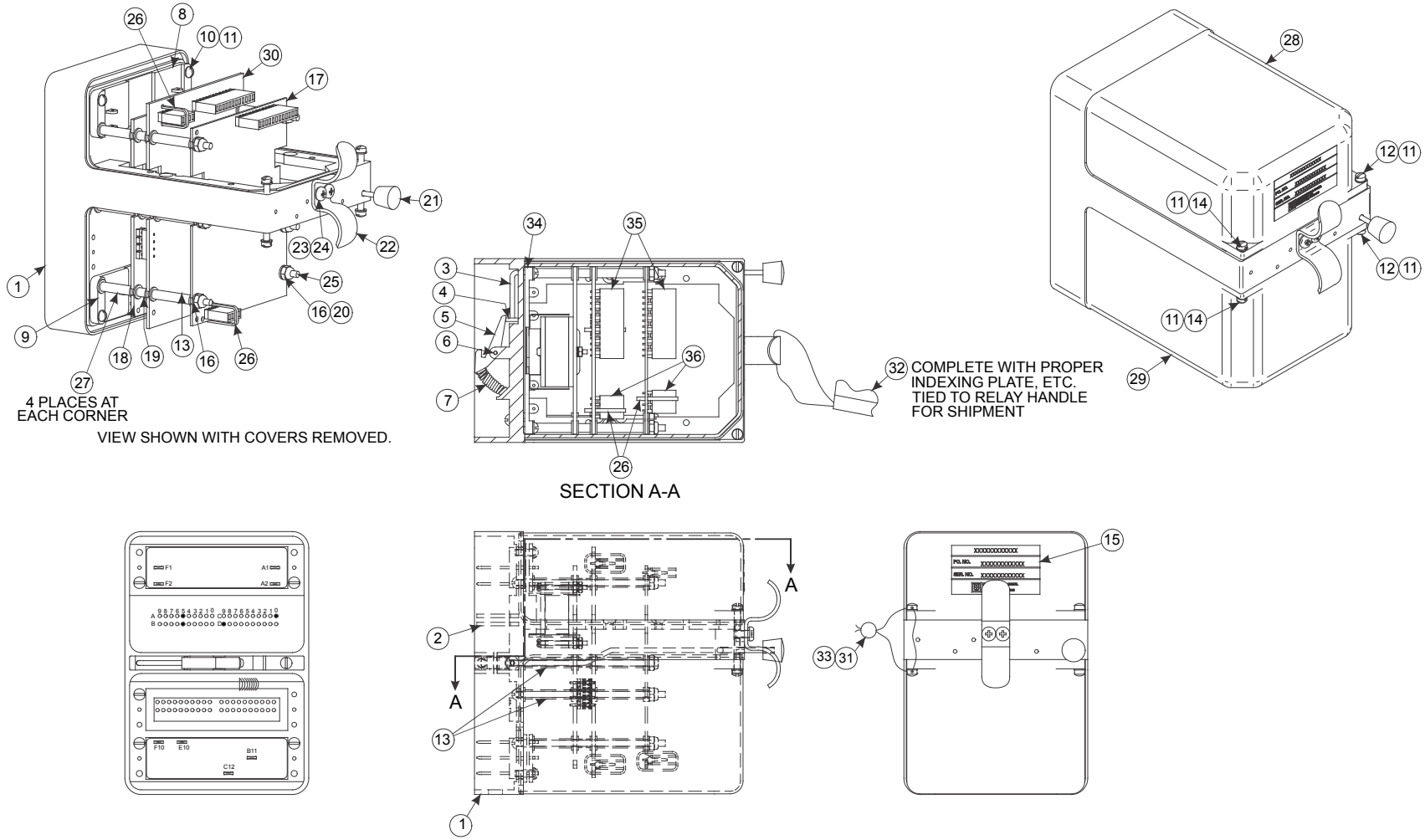

Figure 6-1. Electronic Vane Relay Component Layout

6.2. Old Style Mounting Base

Table 6-2 lists the parts for the old style mounting base for the PV-250 relays. See Figure 6-2 for the parts location.

Table 6-2. PV-250 Old Style Mounting Base (N376442) Parts List

Item Number	Description	Part Number
5	Base, Molded Relay	J776306
11	Clamping, Block Molded	J776308
16	Clamping, Block Molded	J776317
20	Screw, 6-32 x 5/8” Rd Hd Steel	J525061
25	Strike	M321745
30	Nut, .312 Brass Hex	M267499
35 (not shown)	Sheet, Instruction Form 7	S000007
40	Tag, Vinylite	J075828
45	Screw, 4 x 3/16” Rd Hd	J052674
50 (not shown)	Bag,-Parts (includes items 55 – 90)	J078399
55 (not shown)	Screw, 1/4-20 x 1-1/4” Rd Hd	J052667
66 (not shown)	Spare Contact Receptacle, Solderless, for #10 to #12 Wire	J680165
80 (not shown)	Washer, 1/4” Steel Lock Med	J047775
85 (not shown)	Washer, 1/4” Steel Plate	J047501
90 (not shown)	Nut, 1/4-20 UNC 2B HVY	J048002
96	Clamping, Block Molded	J776318

When a complete Mounting Base is ordered, a plastic bag of parts (Item 50) is included in the inner carton with the mounting base and instruction sheets. The bag contains Items 55 through 90 in Table 6-2. A meter test plug (STS USA part number N322965) and contact receptacle extraction tools (STS USA part number J077931) are supplied separately.

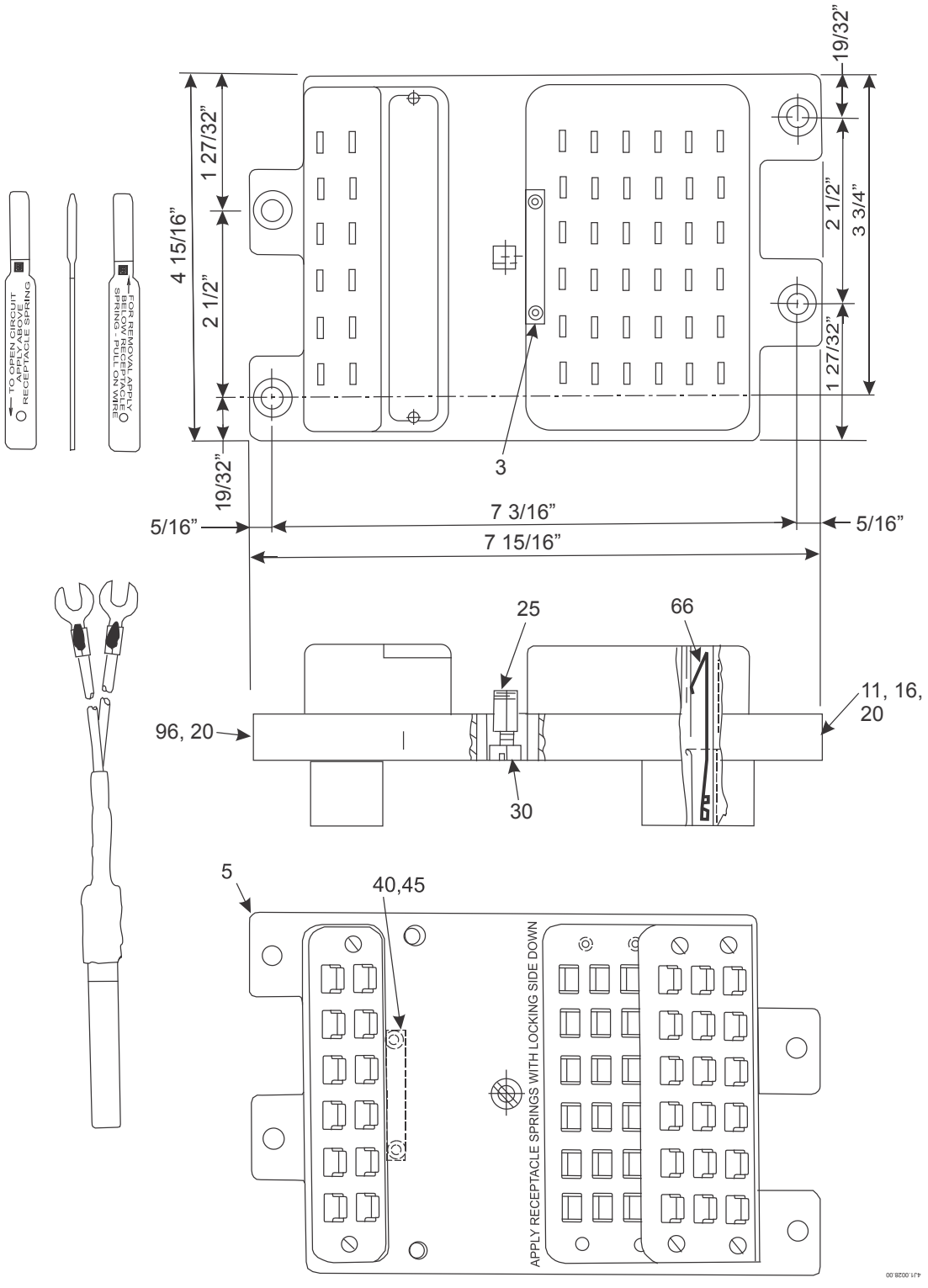

Figure 6-2. Parts Location for PV-250 Old Style Mounting Base (N376442)

6.3. Improved Mounting Base

Table 6-3 lists the parts for the improved mounting base. See Figure 6-3 for the parts location.

Table 6-3. PV-250 Improved Mounting Base (N438689003) Parts List

Item Number	Description	Part Number
1	Base, Mounting Molded 250	J780054
2	Strike	J792848
3	Nut, Speed Push On	J480280
4	Contact, Spring	M4511422702
5	Tag,-Relay Identification	J075951
6	Screw, SST 1/4-20 x 1-1/4”	J5001360120
7	Washer, SS Lock No 1/4”	J4751210111
8	Washer, SST Plate No 1/4”	J4751200112
9	Nut, 1/4-20 SST Hex	J4802110108
10 (not shown)	Sheet, Instruction Form 8	S000008
11 (not shown)	Bag, Parts (includes items 5 – 9)	J078399
15 (not shown)	Screw, 4 x 3/16” Rd Hd	J052674

When a complete Mounting Base is ordered, a plastic bag of parts (Item 11) is included in the inner carton with the mounting base and instruction sheets. The bag contains the Items 5 through 9 in Figure 6-3. A meter test plug (STS USA part number N322965) and contact receptacle extraction tools (STS USA part number J772383) are supplied separately.

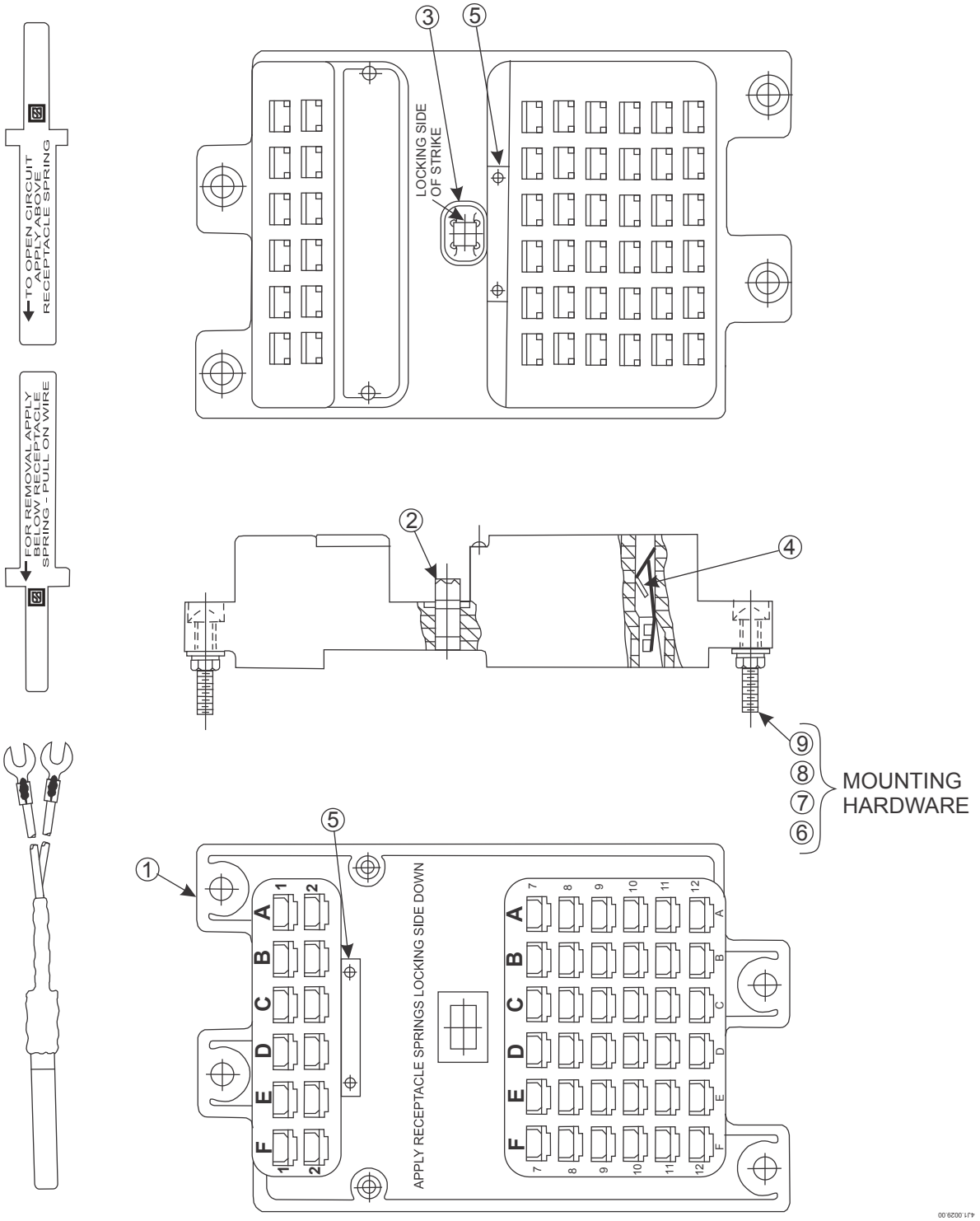

Figure 6-3. Parts Location for PV-250 Improved Mounting Base (N438689003)

7. RAIL TEAM AND 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 in the United States at 1-800-652-7276 or by e-mail at railteam@hitachirail.com.

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End of Manual