PN-159B Biased D.C. Car Carried Plug-In Relay

For 24V Systems

ASTS USA Part No.
N436788

- Installation
- Operation
- Troubleshooting

Proprietary Notice

Important Notice

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

ASTS 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 ASTS USA spare parts are used as replacements.

Revision History

REV.	DATE	NATURE OF REVISION
0	December 1973	Initial issue
1.0	June 2008	Revised to incorporate ECO CRS-01380 and various other updates.
2	May 2011	Added Section 4.1.

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1. GENERAL INFORMATION

This specification contains information for the adjustment, calibration and testing of the PN-159B D.C. Plug-In Relay. Except for the center pivoted armature and the use of hold down coil springs with modified pole piece structure, this relay is the same as the PN-150B relay (Service Manual 4551).

The contacts (6F-6B) are low voltage silver to silver impregnated carbon fronts and silver to silver backs. This relay was designed for car carried vital applications. It is biased and has a balanced armature.

Table 1-2 contains a summary of adjustments. Table 3-1 contains calibration values.

1.1. Safety Summary

Read and thoroughly understand this manual before attempting any of the procedures listed. Pay particular attention to:

CAUTION

and

WARNING

These headings may appear throughout this manual. Caution statements indicate conditions that could cause damage to equipment. Warning statements indicate conditions that could cause physical harm, serious injury, or loss of life. Always observe standard precautions familiar to trained electrical technicians. Always adhere to all safety regulations stipulated by the railroad.

1.2. Abbreviations and Acronyms

The following are abbreviations and acronyms used in this manual along with their associated meanings.

ASTS USA Ansaldo STS USA, Inc. (formerly known as Union Switch & Signal Inc.)

VDC Volts Direct Current

1.3. Specifications

The operating specifications for the N436788 PN-159B Relay are shown in Table 1-1.

Table 1-1. Relay Specifications

COIL:	400 / 400 Ω
CONTACTS:	6 FB Dependent
FRONT CONTACTS:	Silver-Impregnated Carbon
HEEL CONTACTS:	Silver
BACK CONTACTS:	Silver
SYSTEM OPERATING VOLTAGE:	24 VDC

The mechanical specifications for the N436788 PN-159B Relay are shown in Table 1-2 and illustrated in Figure 1-1.

Table 1-2. Mechanical Adjustment Specifications

ARMATURE AIR GAP	ARMATURE STROKE	ADJUSTING SPACER					MINUMUM HOLD-DOWN
		Heel Contact	Front Open	Front Closed	Back Open	Back Closed	
0.023 in.	0.170 in.	0.085 in.	0.065 in.	0.058 in.	0.113 in.	0.120 in.	320 grams

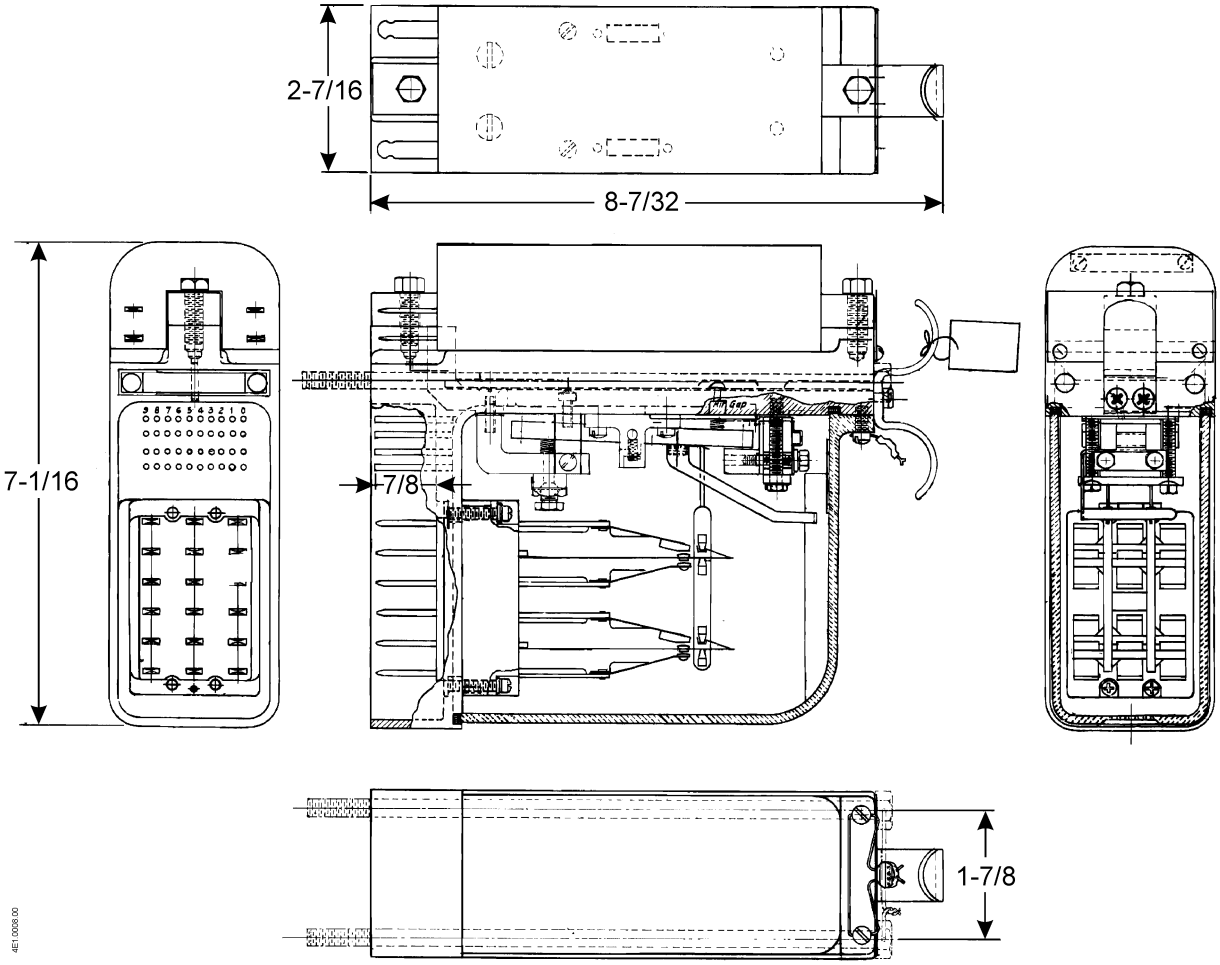

Figure 1-1. Overall Dimensions of the PN-159B Relay

2. ADJUSTMENT AND REPLACEMENT PROCEDURES

2.1. Armature Air Gap Adjustment

The armature air gap at the center of each armature tip is set at the factory to 0.023". The air gaps along the rest of the tips should not vary more than ±0.002" from this value. The stop pins should strike the pole faces as nearly flat as possible. Safety stop pins must not touch the pole faces.

2.2. Permanent Magnets

2.2.1. General

These magnets are of a special alloy that permits retention of proper strength indefinitely if not abused. When not in place on relays, magnet assemblies should be kept separately with the screws tight which hold the shunt and extension to the magnet. These screws should never be loosened sufficiently to let the shunt be separated from the magnet even when on the relay as this would weaken the magnet considerably. Should a magnet become weakened, we suggest that it be re-turned to our factory for recharging due to the special equipment required to charge the magnet fully and then age it to its best working strength.

The polarity of the magnets should be such that the top (end farthest from the two notched holes) will attract the end of a compass needle which points toward geographic south.

2.2.2. Magnet Assembly

The magnet assembly should be applied to the pole piece as shown in Fig. 1 making sure that the shunt between the magnet and the magnet extension is touching the pole piece. Tighten the two long screws holding the magnet assembly to the pole piece sufficiently to straighten the curved strap against the magnet. Bend the nut locks securely up against the sides of the screw heads.

2.2.3. Magnet Adjustment

The permanent magnet extension should be adjusted so that it just touches the two pins on the bottom of the armature with the nominal spacer, specified in Table 1-2, inserted between the main armature stop pin and the upper pole face (armature stroke). If necessary, in order to obtain contact openings, this spacer may be varied within the limits given in Table 1-2.

With the armature released, both back stop pins should make contact with the permanent magnet extension face and neither should project over the magnet extension. In this position, the air gap at the permanent magnet pole face should average 0.004 inch parallel and must not be less than 0.003 inch at any point. This is the physical air gap from plated pole face to plated armature.

2.3. Contact Block Replacement

If the contact block is to be replaced by another, remove the old block, then use a small punch to remove the small dowel pins. Attach the new block with the four screws. Run a #42 drill (.0935 dia.) through the dowel pin holes into the contact block for a total depth of 9/16" + 1/32" – 0".

Carefully install the dowel pins, tapping in until they are flush with the surface.

If it is necessary to install a used contact block from another relay, remove only one of the dowel pins from the aluminum frame. Carefully press the block on the remaining pin and fasten in place with the screws. One dowel pin will adequately hold the block in place.

2.4. Front and Back Contact Adjustment

With the armature stop pin picked up against the "Front Open Spacer" called for in Table 1-2, each front contact shall be barely open. With the "Front Closed Spacer" all front contacts must be making, at least one button.

With the armature stop pin picked up against the "Back Open Spacer" called for in Table 1-2, each back contact shall be barely open. With the "Back Closed Spacer" all back contacts must be making, at least one button.

With the relay at full-stroke, all front contact buttons must be making. With the relay at full-drop-away, all back contact buttons must be making. As viewed from the side, contacts must make and compress with the point of contact between limits of 1/3 and 2/3 of the diameter of the button.

2.5. Contact Drivers – Heel Spring Adjustment

NOTE

Section 2.5 and Figure 2-1 apply only to the older stick-driver style of PN-159B relay.

With the relay upright and the armature stop pin picked up against the "Heel Contact Spacer" called for in Table 1-2, adjust the heel springs until each driver will fall into engagement at all slots when moved rearward onto its heel springs and the driver bracket. Adjust by bending the fingers of the driver bracket, and if necessary by slight bending at the reduced section of each heel spring. During this adjustment the front and back contacts must be open.

Install the driver retaining clips. The driver bracket must be adjusted with respect to the armature so that with the armature fully released, when each driver is pulled toward the front of the relay all slots will remain properly engaged. Proper engagement means that at least ½ of each narrow slot engages the heel spring, and that the wider slot engages at least ½ the thick section near the end of the bracket finger. But the driver must be free enough in all armature positions that there can be no binding with respect to bracket or springs.

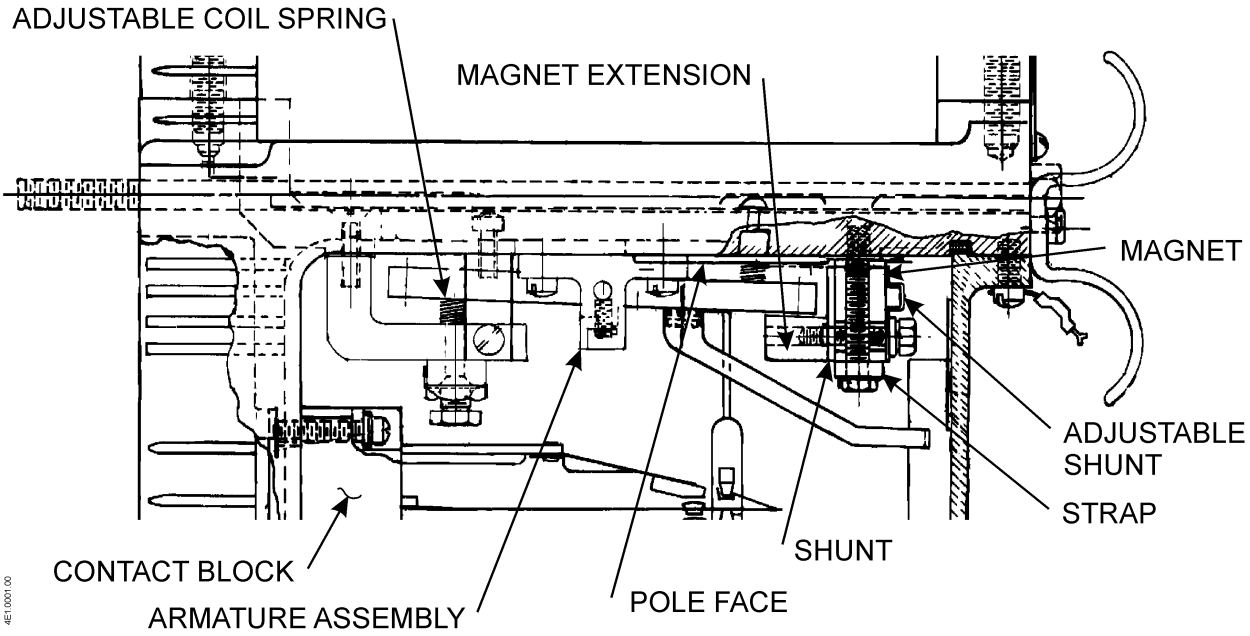

Figure 2-1. Permanent Magnet Assembly Details

3. RELAY CALIBRATION

After the relays have been inspected and adjusted, they should be calibrated to meet the values given in Table 3-1. Before calibrating, the relay should be energized at the "charge" value and no higher, the energization being pole changed several times allowing the current to build up to full value in each direction.

3.1. Polarity

Verify relay polarity with the following steps.

1) With the negative power lead connected to the "+" or "+A" coil terminal, the positive power lead connected to the "-" or "-B" coil terminal, and the relay energized at the "Charge" value, the armature should not pick up. With the relay energized at the reverse polarity so that the positive power lead is connected to the "+" or "+A" coil terminal, the relay should pick up. The "+" or "+A" coil terminal is the left-hand coil terminal on the relay as viewed from the front of the relay.

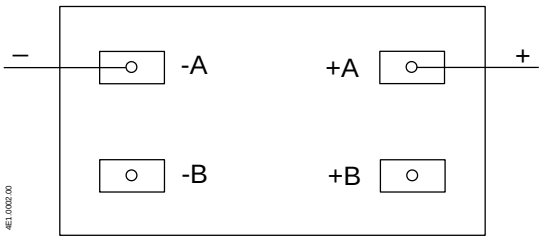

Figure 3-1. Mounting Base Connections: Coils +A/-A or +B/-B

2) With the negative power lead connected to the "+A" coil terminal, the positive power lead connected to the "-B" coil terminal and with applicable jumpers as illustrated in Figure 3-2 and the relay energized at the "charge" value, the armature should not pick-up. With the polarity of energization reversed so that the positive power lead is connected to the "+A" coil terminal, the relay should pick-up. The "-FA" coil terminal is the upper left-hand coil terminal on the relay as viewed from the front of the relay.

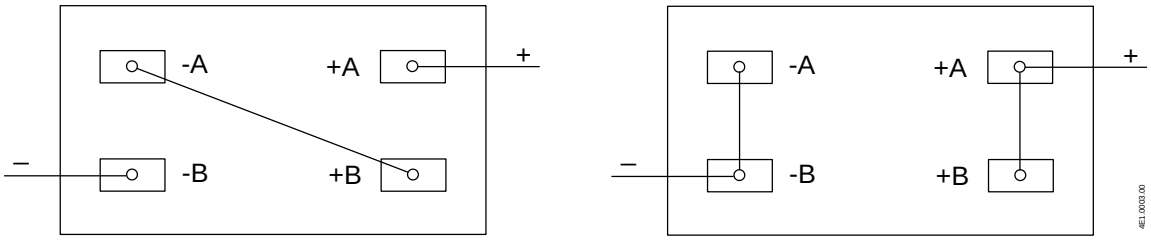

Figure 3-2. Mounting Base Connections: Series or Multiple Coils

3.2. Drop-Away

The relay should be given a charge of four times the pick-up value and the current then gradually reduced until the armature drops away, opening all front contacts. This value should be within the values specified in Table 3-1.

The full drop-away, back contacts fully compressed (armature resting on the permanent magnet extension) must be not less than the minimum drop-away in Table 3-1. Shims (0.001") can be used at one or both ends of the backstrap to meet the drop-away limits.

3.3. Pick-Up

Immediately after the drop-away value has been measured, the current should be reduced to zero, the circuit opened for one second, then the current again applied in the same direction gradually increasing it until the armature moves away from the permanent magnet with a very definite sudden motion. This value should not be more than 95% of the actual pick-up value measured on the tested 6-point relay.

The current should be further increased until the armature picks up to close the front contacts and the armature stop pins close against the pole piece. This value should not be more than that specified for maximum Pick-Up and Working in Table 3-1 . The pick-up value can be varied by adjusting the hold down coil spring.

CAUTION

Electrical timing characteristics of the relay are changed if the relay hold-down bolts are excessively tightened. In all systems where the PN-159B relay is used, the bolts (R451299-0102) must be tightened with a torque wrench to 25 in.-lbs. ±5 in.-lbs.

Table 3-1. Calibration Values For Relays with 6F–6B LV Contacts

Coil (Ω)		Charge (V)	Drop-Away (V)		Full Back Contact Pressure Drop-Away (V)	Maximum Pick-Up and Working (V)	
Winding A	Winding B		Minimum	Maximum		Minimum	Maximum
400		66	9.0	11.0	5.5 min.	15.0	17.0
	400	66	9.0	11.0	5.5 min.	15.0	17.0
800	(Series)	66	9.0	11.	5.5 min.	15.0	17.0
200	(Multiple)	33	4.5	5.5	2.75 min.	7.0	9.0

4. RELAY SERVICE TESTS

4.1. Periodic Performance Test

All vital relays must be inspected and tested at least once every four (4) years. The tests and inspections are to include: pick-up current, drop-away current, timing of slow operating and timing relays; and visual inspection of contacts for damage or misalignment, corrosion or other contamination of parts, loose parts inside of the cover, broken seal, and cracked or broken cover.

All vital relays installed in locomotive or car-carried equipment are to be removed from service and adjusted, repaired and tested at least once every six (6) years.

Relays not passing the tests and inspections must be removed and not returned to service until the operating characteristics and conditions are in accordance with ASTS USA specifications.

4.2. Readjustment Values

It is recommended that relays in service be readjusted when one or more of the following conditions occur, using as reference the calibration values for new relays given in Table 3-1.

- Drop-Away value falls below 90% of the new relay value.
- Drop-Away with Full Back Contact Compression (armature resting against permanent magnet) value falls below 33% of the new relay value.
- Pick-Up value increases to more than 110% of the new relay value.

4.3. Contact Opening Verification

With the armature against the permanent magnet extension, the front contacts must have at least 0.050 opening

With the back contacts just closed, there should be a 0.020 minimum front contact opening.

With the relay upright, the armature should be moved to a position such that each heel spring is transferring between top and bottom of its slot in the driver. In this position, both front and back contacts should be standing open at least 0.005.

4.4. Permanent Magnet Hold-Down Force

With the relay in the normal upright position and de-energized, a force measured with gage Pc. UN105440 of at least 320 grams applied at the bottom of the centermost contact driver should be required to cause the armature to move away from the permanent magnet. This check should be made before and after the relay has been calibrated and after energizing with the charge value using normal polarity of energization.

Because of the allowable variation in the stiffness of the material from which the contact springs are made, the hold down force may vary between relays that have the same strength magnets. For this reason; on relays that have 380 grams or more hold-down force (using nominal spacers) replace one of the phosphor bronze screws (shiny nickel plating) that holds the magnet assembly to the pole piece with a dull tin plated steel screw UJ463078 which will shunt some of the magnetic flux. Bending the adjustable shunt away from the magnet slightly will raise the hold-down force if necessary.

4.5. Contact Resistance

Resistance of front contacts should be measured with the relay energized and the armature against the stop pin, that of back contacts with the armature in the de-energized position. Cleaned contact resistances must not exceed the values given in Table 4-1.

Table 4-1. Contact Resistance Specifications

CONTACT TYPE	FRONT CONTACT (Ω)	BACK CONTACT (Ω)
Silver-to-Silver Impregnated Carbon	0.09	0.18
Silver-to-Silver	---	0.03

5. PARTS LISTS

5.1. PN-159B Relay M436788

Table 5-1 lists the parts for the PN-159B Relay. Refer to Figure 5-1 and Figure 5-2.

Table 5-1. PN-159B N436788 Parts List

ITEM	PART NUMBER	DESCRIPTION	QTY.
5	M436776	RELAY FRAME	1 EA
7	M263916	GUIDE,SPRING	1 EA
8	M275388	NUT,.006X5/16 STEEL LOCK	1 EA
10	J487087	PIN,SPRING,SLOTTED,3/32"X3/8",420SS	1 EA
15	M436770	BLOCK,SUPPORT	2 EA
20	M436764	POLE,PIECE	1 EA
25	J052066	SCREW,8-32X5/8 FL HD	2 EA
30	M436771	PLATE,1/8X1/2 BRASS	1 EA
35	N436786001	ARMATURE	1 EA
39	S003665	TAG	1 EA
50	N438633	CONTACT,BLOCK	1 EA
51	N3306817800	BAG PARTS	1 EA
55	J5072980120	SCR-SST 6-32X3/4 FH	4 EA
60	M436773	ARMATURE BRACKET PN-159B	1 EA
65	M341808	PIVOT,1/4 STEEL RD	2 EA
70	J050731	SCREW,8-32X5/16 SAFSET	2 EA
75	.00135210	SCREW, 6-32X1/2" FIL HD	4 EA
76	M432380	INDICATOR, ARM.POS.	1 EA
80	PN436768	MAGNET PERM	1 EA
125	M321853	STRAP,MAGNET STEEL	1 EA
130	J4751210127	WSHR-SST .170 ID FLT	4 EA
135	J052242	SCREW,6-32X3/8 FIL HD	4 EA
140	J561111	HANDLE,PULL ALUMINUM	1 EA
145	J4751210125	WSHR-SST #10 SHAK PF	2 EA
150	J5072960129	SCR-SST 10-32X3/8 PH	2 EA
152	M196812	WASHER	2 EA
155	N436791	COIL,ENCAPSULATED PN159B	1 EA
160	J051070	SCREW,6-32X3/8 FL HD BRASS	2 EA
165	M310328	SPRING,GUIDE SCREW	1 EA
170	J5000970112	SCREW,1/4-20X3/4 HEX HD SS	2 EA
175	J4751210107	WASHER,SST LOCK NO 6	8 EA
180	M4511088001	PLATE,NAME	1 EA

Table 5-1. PN-159B Relay N436788 Parts List (continued)

ITEM	PART NUMBER	DESCRIPTION	QTY.
185	J480014	NUT-1/4-28 HEX BRASS	1 EA
190	J047081	GASKET,RUBBER	1 EA
195	J776596	COVER,MOLDED RELAY	1 EA
210	J5072950119	SCREW,8-32 X 7/16"L,FIL HEAD	2 EA
215	A043013	WIRE-SEAL #22 AWG, 2 PLY	0.500 FT
220	J079351	SEAL-SECURITY, GRAY	1 EA
225	M436772	CONTACT,SPRING STEEL COIL	2 EA
250	M253273	NUT LOCK	1 EA
255	J463078	BOLT,8-32X1-1/4-STEEL	1 EA
260	M327179	SCREW,1/4 HEX HD BRONZE RD	1 EA
265	M376608	SHIM,BRONZE PHOS STP	4 EA
280	J5072980121	SCR-SST 6-32X1/ HEX	2 EA
285	M349785	SPRING #26 PHOS BRONZE RD	1 EA
295	J525024	SCREW,4-40 X 3/16,PAN HD,SS	2 EA
300	J792919	BOLT,LOCK MONEL MET	2 EA
305	M347526	SPACER,.0548X48X120 STEEL SHT	1 EA
310	J487090	PIN,ROLL-3/32DX1-1/8	4 EA
315	M437208	SHIM,.001 STOCK	2 EA
320	M373632001	ARM,OPERATING	1 EA
325	M376608001	SHIM	2 EA
330	J792756	INSERT,6 32 SLF CL SS	4 EA
335	J4751210107	WASHER,SST LOCK NO 6	4 EA

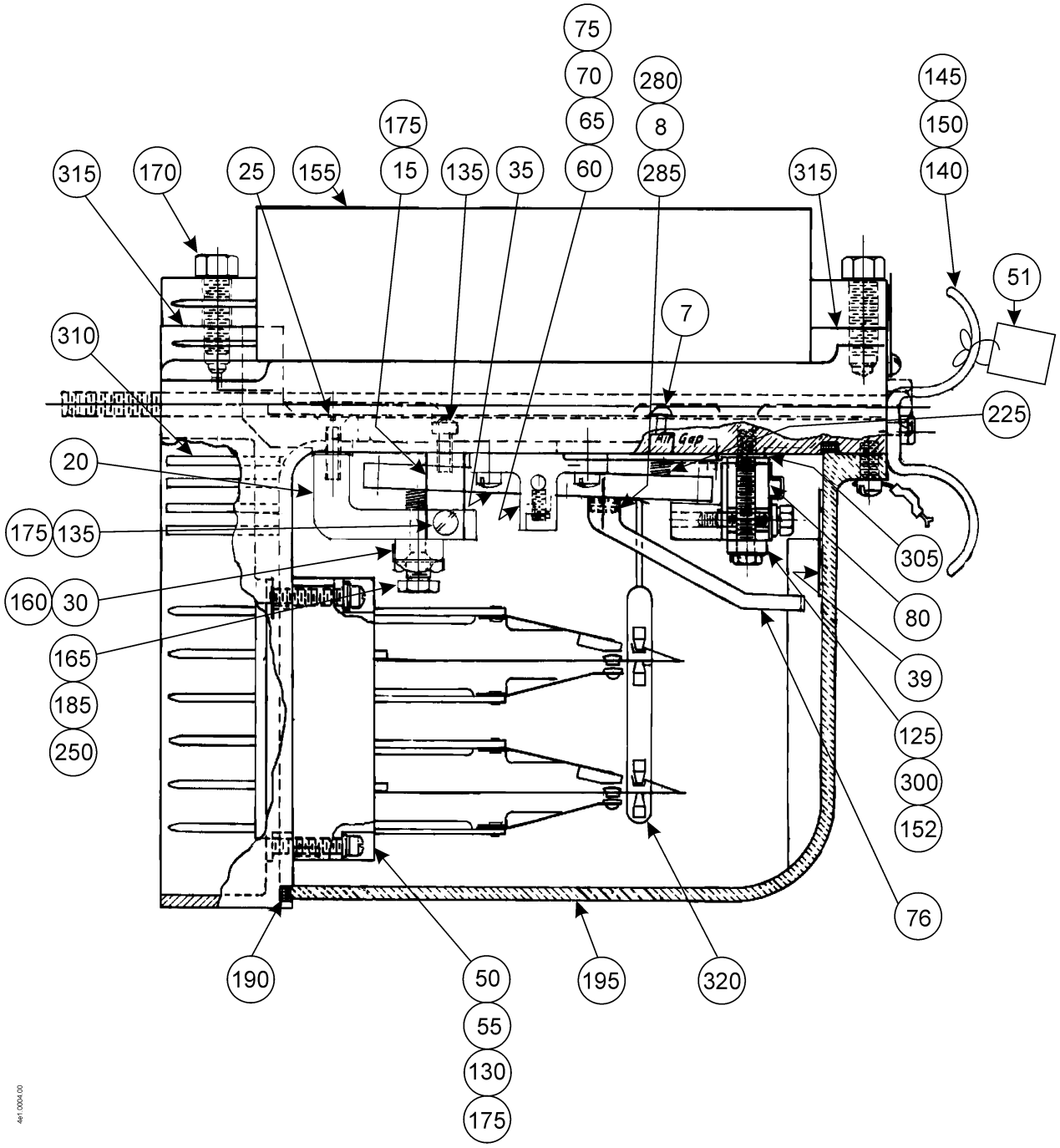

Figure 5-1. PN-159B Relay Parts Detail (Sheet 1)

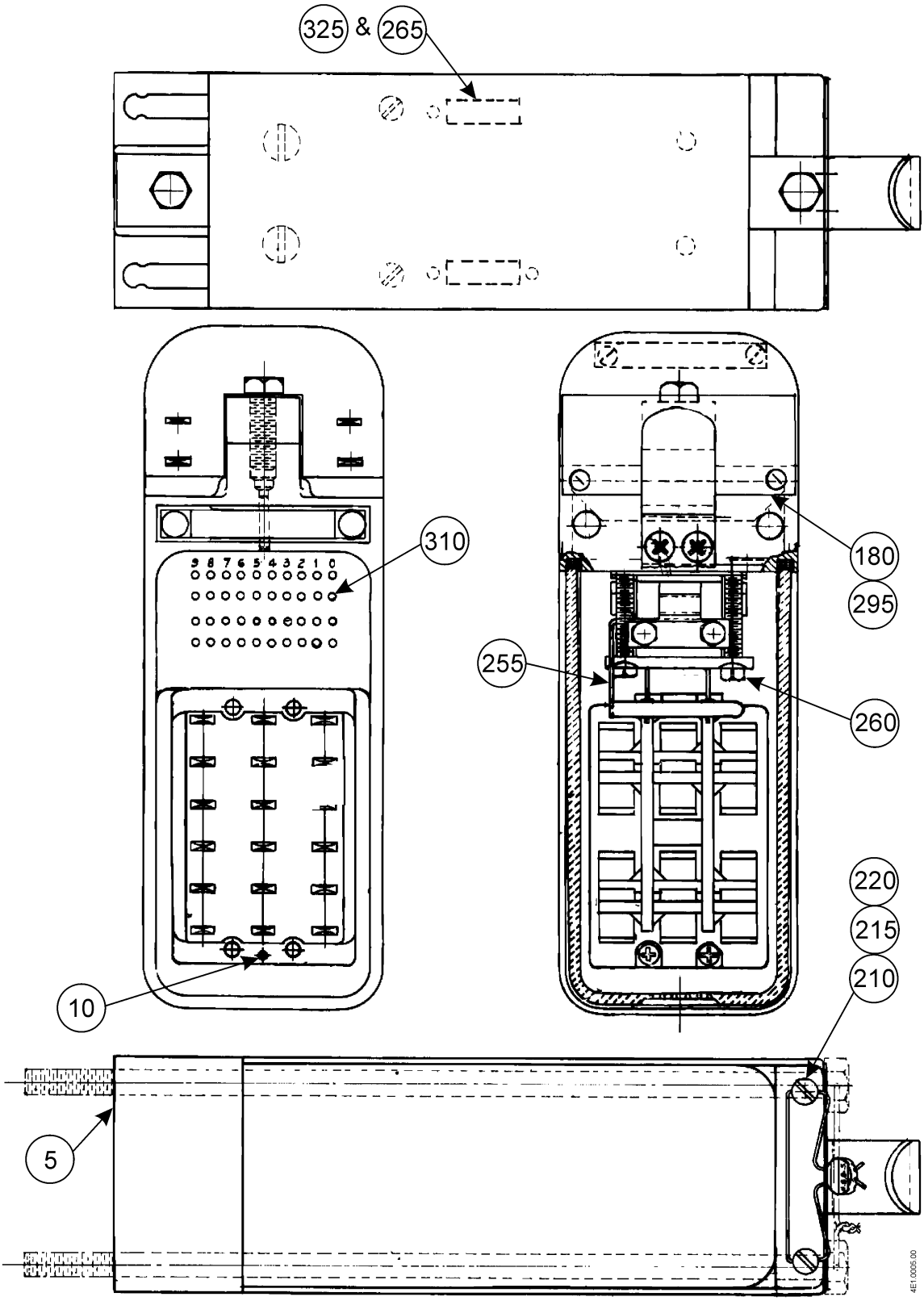

Figure 5-2. PN-159B Relay Parts Detail (Sheet 2)

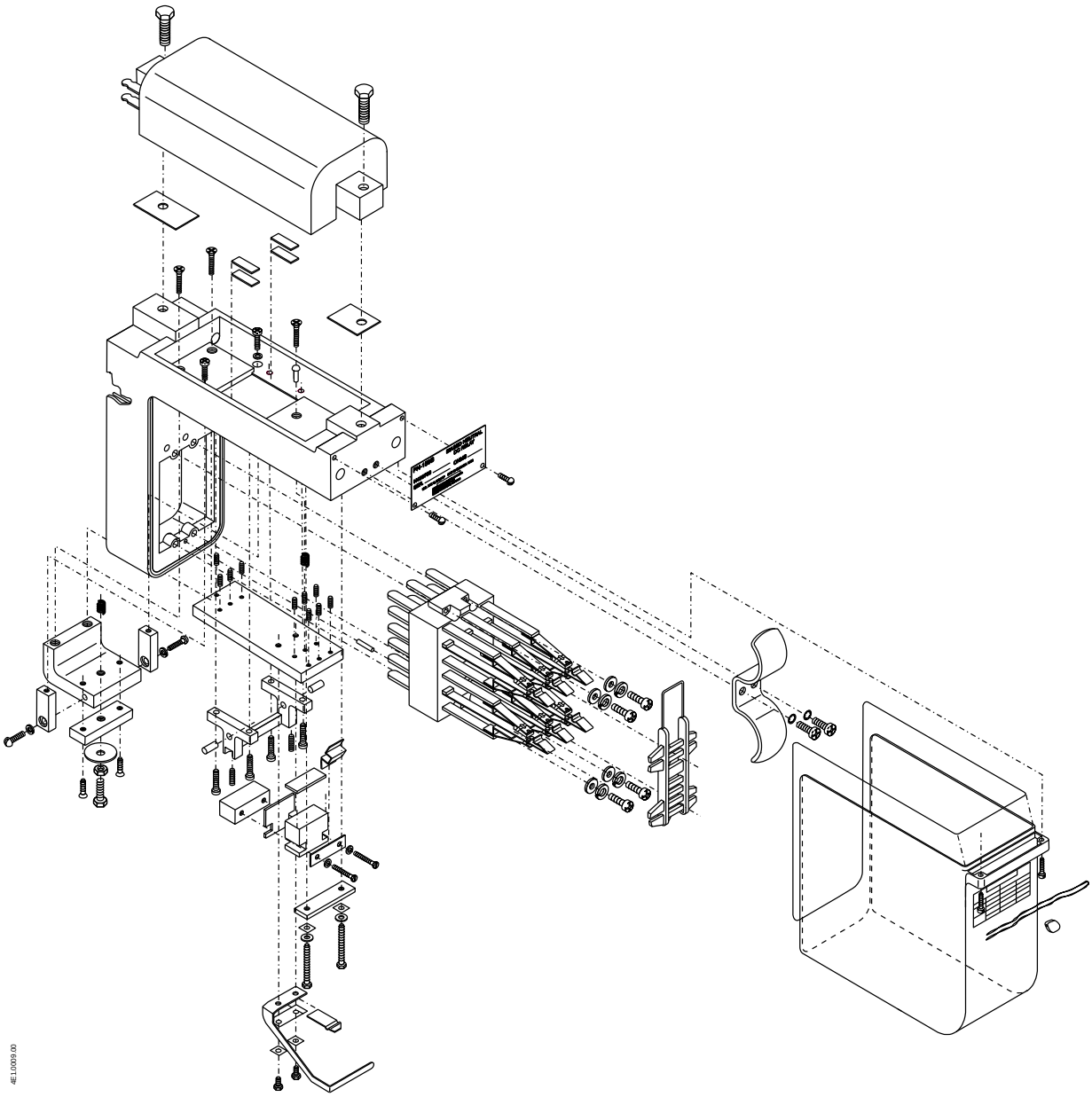

Figure 5-3. PN-159B Relay, Exploded View

5.2. Relay Mounting Base N451376-0303

Table 5-2 lists the parts for the new style, solderless PN-159B Relay Mounting Base. Refer to Figure 5-4.

Table 5-2. Mounting Base for Car-Carried Relays

ITEM	PART NUMBER	DESCRIPTION	QTY.
1	J780055	BASE, MOUNTING MOLDED	1 EA
3	J792848	STRIKE RELAY	1 Ea
4	J480280	NUT, SPEED PUSH ON	1 EA
5	M4511422703	SPRING CONTACT	20 EA
6	J5001360120	SCR – SST, ¼-20 x 1-¼	2 EA
7	J4751210111	WASHER, SST, LOCK, NO. 1/4	2 EA
8	J4751210112	WASJER, SST, PLATE, NO. ¼	2 EA
9	J4802110108	NUT, ¼-20, SST. HEX	2 EA
10	J075951	TAG, RELAY IDENTIFICATION	2 EA

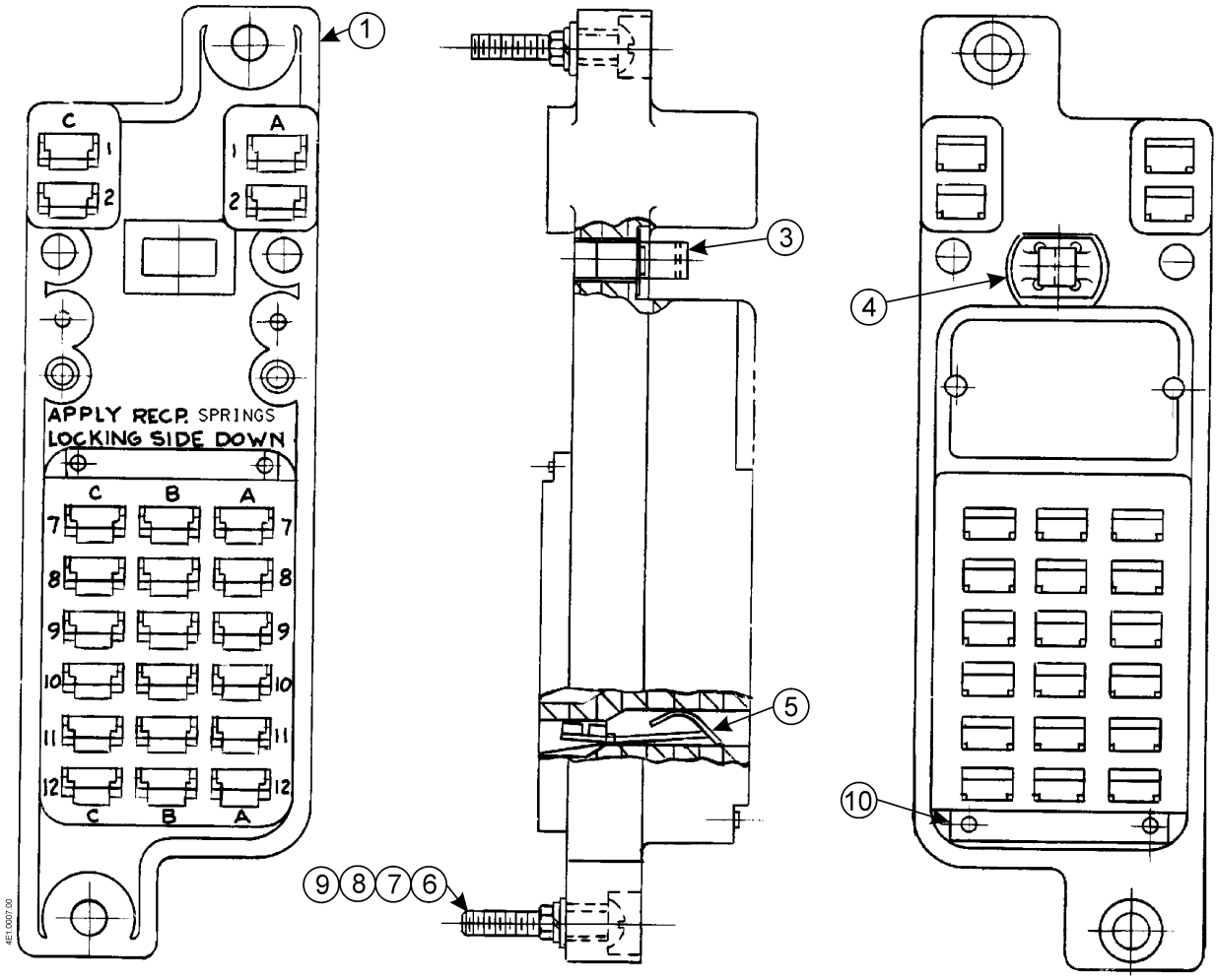

Figure 5-4. PN-159B Relay Mounting Base

5.3. Relay Mounting Base N436797

Table 5-3 lists the parts for the original style PN-159B Relay Mounting Base.

Table 5-3. PN-159B Mounting Base (Original)

PART NUMBER	DESCRIPTION	QTY.
M436796	BASE	1 EA
J078458	CLPING PL-PN-150	1 EA
J078459	BLOCK-MOLDED CLMPNG	1 EA
J522090	SCREW,6-32X5/8 FIL HD STEEL	6 EA
S000007	SHEET,INSTR.FORM7	1 EA
J078399	BAG-PLASTIC,#60F-0406	2 EA
J075828	TAG VINYLITE	2 EA
J052674	SCREW,4X3/16 RD HD	4 EA
J047711	WASHER,CORK GR240 FINE	2 EA
J680165	SPR CONTACT RCPT	20 EA
J052667	SCREW,1/4-20X1-1/4 RD	2 EA
J047775	WASHER,1/4 STEEL LOCK MED	2 EA
J047501	WASHER,1/4 STEEL PLATE	2 EA
J048002	NUT,1/4-20 UNC 2B HVY	2 EA

6. 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@ansaldo-sts.us.

End of Manual