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

HITACHI
Inspire the Next

PN-250CG
Code Generator Relay

STS USA Part No.	
P20A.005601	P20A.005611
P20A.005602	P20A.005612
P20A.005603	P20A.005613
P20A.005604	P20A.005614
P20A.005605	P20A.005616
P20A.005606	P20A.005617
P20A.005607	P20A.005618
P20A.005608	P20A.005619
P20A.005609	P20A.005621
P20A.005610	P20A.005622

- ♦ Installation
- ♦ Operation
- ♦ Maintenance

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.

1000 Technology Drive, Pittsburgh, PA USA 15219-3120
645 Russell Street, Batesburg, SC 29006
sts.hitachirail.com

Revision History

Rev.	Date	Nature of Revision
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Table of Contents

1. INTRODUCTION 1-1
1.1. Purpose 1-1
1.2. Terms, and Acronyms 1-1
1.3. Overview 1-1
1.4. Brief History 1-1
2. EQUIPMENT DESCRIPTION 2-1
2.1. Circuit Overview 2-1
2.2. Contact Ratings 2-1
2.2.1. Low Voltage Switches 2-1
2.2.2. High Voltage Switches 2-1
2.3. Contact Switching Time 2-1
2.3.1. Low Voltage, AC/DC, Switching Time 2-2
2.3.2. High Voltage, AC Only, (Zero-Cross), Switching Time 2-2
2.4. Duty Cycle 2-2
2.5. Index Keying 2-3
2.6. Specifications 2-4
3. CONFIGURATIONS AND CROSS REFERENCE 3-1
4. INSTALLATION AND OPERATION 4-1
4.1. Replacement Installation Procedure 4-1
4.2. New Installation 4-1
4.3. Verify Operation 4-2
4.4. PN-250CG Dimensions 4-3
5. MAINTENANCE AND PERIODIC INSPECTION 5-1
6. TECHNICAL SUPPORT 6-1

List of Figures

Figure 1-1. PN-250CG Relay Front View 1-2
Figure 1-2. PN-250CG Relay Rear View 1-2
Figure 2-1. PN-250CG Block Diagram 2-3
Figure 2-2. Contact Location, Top Rear of PN-250CG Case 2-4
Figure 4-1. PN-250CG Relay Dimensions 4-3

List of Tables

Table 2-1. PN-250CG Contact Switching Time 2-2
Table 2-2. Contact Duty Cycle 2-2
Table 2-3. IEC 61000-6-4 Compliances 2-5
Table 3-1. PN-250CG Configurations and Cross Reference 3-1
Table 4-1. Crimping Tools 4-2


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1. INTRODUCTION

1.1. Purpose

This service manual provides description and installation information for Hitachi Rail STS USA's PN-250CG Solid-State Code Transmitter Relay, P20A.0056xx series, Figure 1-1 and Figure 1-2.

1.2. Terms, and Acronyms

In this document, the **PN-250CG SS, Solid-State Code Transmitter Relay** will simply be referred to as PN-250CG.

Term / Acronym	Definition
CPM	Codes Per Minute
FET	Field Effect Transistor
HV	High Voltage
LV	Low Voltage
MOSFET	Metal-Oxide Semiconductor Field-Effect Transistor
MOV	Metal Oxide Varistor
SS	Solid-State
Switch/Relay/Contact	The solid-state switches used in the PN-250CG Relay are also considered relays. In this document, the solid-state switches may be referred to as switches, relays, or contacts, to fit the narrative.
TVS	Transient Voltage Suppression

1.3. Overview

The PN-250CG is a solid-state code transmitter (also known as a code generator) and is a direct replacement for the PN-250TR (N3225560xx series) electromechanical coder relay. This PN250CG also replaces its solid-state predecessor, the N4010560x series. The PN-250CG is available in several code rates and contact arrangements for driving traditional code following relays (using LV contacts), or for directly switching 120 Vac (using HV contacts). The available PN-250CG models are listed in Table 3-1.

1.4. Brief History

As background, the old electromechanical PN-250TR code transmitters operate by using an electromagnetic circuit to sustain the motion of a pendulum to generate a pulsed signal, (aka code rate). The code rates are dependent on the pendulum's natural period of oscillation, which alternately opens and closes a set of contacts at rates of 50, 75, 120, 180, 270, or 420 codes per minute, or CPM. One set of contacts is closed for nearly one-half of the pendulum's motion, and for the opposing range of motion, a second set of contacts is closed. Since the contacts are arranged as break-before-make, both sets are alternately closed for less than 50% of the oscillation period. This fundamental operation is duplicated electronically by the PN-250CG.

Figure 1-1. PN-250CG Relay Front View

Figure 1-2. PN-250CG Relay Rear View

2. EQUIPMENT DESCRIPTION

2.1. Circuit Overview

In the PN -250CG, an electronic oscillator circuit replaces the aforementioned mechanical pendulum, and is the source of the actual code rate. The oscillator drives two separate comparator circuits, which in turn controls the ON/OFF switching period of the solid-state contacts. Contact status indication is provided by two Light Emitting Diodes (LEDs). A yellow LED indicates that the front contacts are closed, and a green LED indicates that the back contacts are closed. There are four independent contact sets, 2-front and 2-back, with each set having a dedicated heel. The contact sets are all electrically isolated from the others, and from the relay frame. See Figure 2-1 and Figure 2-2 for a block diagram and relay pin-out information.

2.2. Contact Ratings

Two types of solid-state switching devices are used to replace the low voltage (LV) and high voltage (HV) contacts used in a mechanical relay. The HV solid-state contacts are constructed using Triacs, and are designed to switch AC voltages only. The LV solid-state contacts are constructed using Field Effect Transistor (FET) devices, and can switch both AC and DC voltages.

2.2.1. Low Voltage Switches

The low voltage switches (a.k.a., contacts) support AC or DC loads to 3.0 Amps @ 30 volts DC, or 22 volts RMS. The LV switches are transient protected by a MOV and TVS device, with a 23 Vrms or 31 Vdc standoff voltage rating. There is no integral short circuit protection for these switches. If short circuit protection is required, an external fuse must be installed.

2.2.2. High Voltage Switches

For high voltage applications, the switches are AC only (zero-cross) devices. The contact load rating is from a minimum 0.05 Amp hold-current to a maximum of 2.5 Amps at 20 to 120 Vrms. The HV switches are transient protected by a MOV and TVS device, with a 150 Vrms standoff rating. There is no integral short circuit protection for these switches. If short circuit protection is required, an external fuse must be installed.

2.3. Contact Switching Time

The nominal contact switching time, when neither the front nor back contacts are closed, varies from 11 to 36 ms, based on the CPM rate. See Table 2-1 for details.

The contacts are comprised of independent semiconductor devices, and are not force-guided or interlocked as in a mechanical relay. Nevertheless, under normal operation, the contacts are designed to switch in a break-before-make sequence. However, in a scenario where a single contact set fails (short/open), the other contacts may still operate normally. This contingency shall be considered for the relay's application.

Code Rate	Contact Switching Time
50	36 ms
75	24 ms
120	20 ms
180	20 ms
270	15 ms
420	11 ms

Table 2-1. PN-250CG Contact Switching Time

2.3.1. Low Voltage, AC/DC, Switching Time

The LV contacts will switch AC or DC voltages, based on the timing parameters listed in Table 2-1.

2.3.2. High Voltage, AC Only, (Zero-Cross), Switching Time

The HV, AC only, (zero-cross) switches behave differently than the LV, AC/DC switches. Because of their zero-cross design, the HV switches will only change state (open/close) when the AC voltage crosses through the zero volt reference. If the AC waveform is symmetrical, the switching will occur at either the 0° or the 180° phase angle. This switching characteristic can impose close to an additional 0.5 cycle switching delay from the commanded state. At 100 Hz, for example, a 0.5 cycle period is 5.0 ms, so if a HV switch were commanded to close at a 90° phase angle, the switch would not actually close until reaching the 180° point, or approximately a 2.5 ms delay. This delay is anticipated and accounted for in the contact switching time, to ensure a break-before-make operation.

2.4. Duty Cycle

The contact duty cycle varies with the CPM rate, as listed in Table 2-2. As the code rate gets slower, the duty cycle approaches 50%, because the contact switching time (see Table 2-1) becomes less significant at the slower code rates. The duty cycles shown in Table 2-2 are a nominal representation for both the front and back contacts. While the duty cycle does change with temperature, it is only a few tenths of a percent, and insignificant to the relays operation.

Contact State	420 CPM	270 CPM	180 CPM	120 CPM	75 CPM	50 CPM
Closed	42%	43%	44%	46%	47%	47%
Open	58%	57%	56%	54%	53%	53%

Table 2-2. Contact Duty Cycle

2.5. Index Keying

To ensure that units of different code rates or output ratings are not interchanged, index plates are provided with the PN-250CG relay for installation into its corresponding mounting base. Table 3-1 lists the PN-250CG relay versions available by code rate, contact arrangement, and index keying.

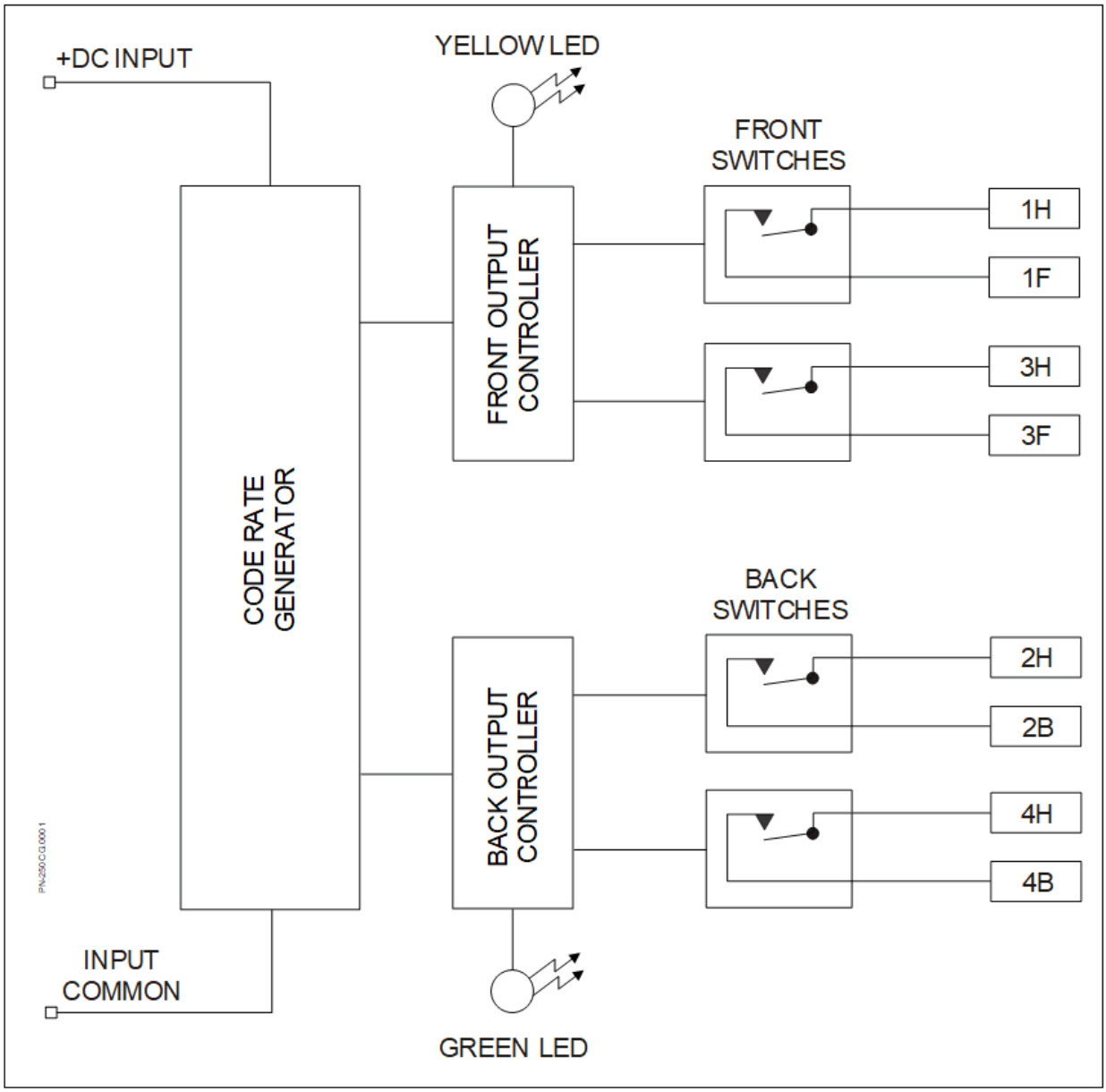

Figure 2-1. PN-250CG Block Diagram

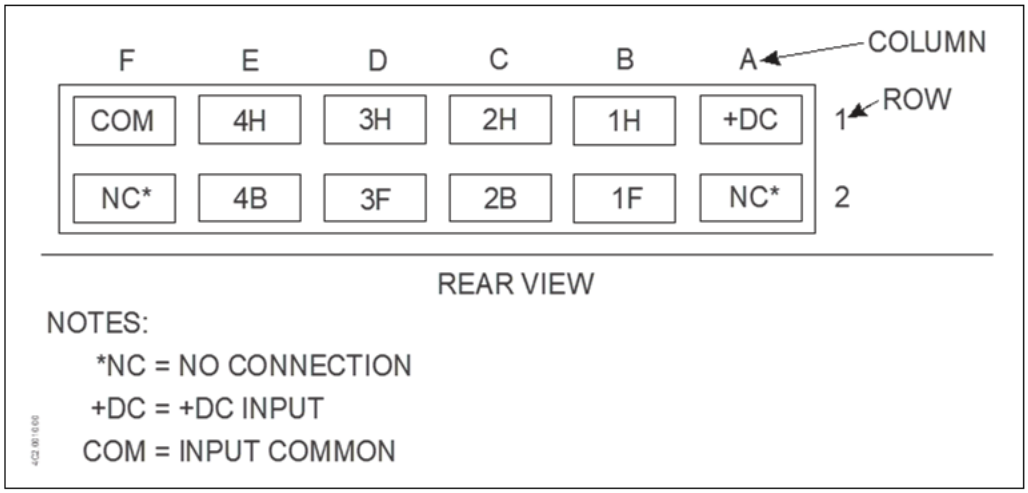

Figure 2-2. Contact Location, Top Rear of PN-250CG Case

2.6. Specifications

Operating Voltage:	9 to 18 VDC, Reverse voltage protected.
Operating Current:	18 mA, +/- 1 mA
Output Switch Ratings:	Low Voltage, AC/DC, 3.0 Amps, 30 Vdc*, 22 Vrms*. ON resistance, including transient inductors, 0.2 ohm. An external fuse is required for short circuit protection. High Voltage, 2.5 Amps, 120 Vrms*, AC only, zero-cross. The voltage drop across an ON switch is approximately 1.1 Vrms, and is independent of load current. An external fuse is required for short circuit protection.
Number of Switches:	Four total, arranged as two front and two back contacts, with independent heel connections. (See Figure 2-1.)
Indications:	Alternately flashing yellow and green LEDs. Yellow indicates the front contacts are closed. Green indicates the back contacts are closed.
Operating Temperature:	-40°C to +70°C (-40°F to +158°F), 0 to 95% relative humidity (non-condensing).

**Maximum voltage is determined by the transient protection devices installed across the switches.*

LV Contacts – 31 Vdc / 23 Vrms

HV Contacts – 150 Vrms, anticipating 120 Vrms as the source voltage

Dielectric strength: 3000 Vrms for one minute between all external isolated connections and case, except across open switches, which are limited by TVS and MOV protection devices.

EMC/EMI IEC 61000-6-4 Compliances:

Test Description	Specification	Results
IEC 61000-6-4		
Conducted Emissions	CISPR 16-2-1/IEC 55016-2-1	Complied
Radiated Emissions	CISPR 16-2-1/IEC 55016-2-1	Complied
Electrostatic Discharge Immunity	EN 61000-4-2:2008	Complied
Radiated Electromagnetic Field Immunity	EN 61000-4-3:2010	Complied
Fast Transient/Burst Immunity	EN 61000-4-4:2012	Complied
Surge Immunity	EN 61000-4-5:2014	Complied
Conducted RF Immunity	EN 61000-4-6:2013	Complied
Magnetic Field Immunity	EN 61000-4-8:2009	Complied
Pulsed Magnetic Field Immunity	EN 61000-4-9:2009	Complied

Table 2-3. IEC 61000-6-4 Compliances


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3. CONFIGURATIONS AND CROSS REFERENCE

Table 3-1**Error! Reference source not found.** provides the PN-250CG configurations and cross reference. The two columns on the right show the equivalent superseded PN-250CG and the PC-250TR electromechanical relay part numbers.

Table 3-1. PN-250CG Configurations and Cross Reference

PN-250CG Order No.	Code Rate	Contact Load	Contact Arrangement	Indexing A-B-C-D	Superseded Part Number	PC-250TR Replaced
P20A.005601	180	AC/DC	1F,2B,3F,4B LV	5-6-0-1	N40105601 N40105628	N322556-001
P20A.005602	75	AC/DC	1F,2B,3F,4B LV	5-6-0-2	N40105602 N40105626	N322556-002
P20A.005603	120	AC/DC	1F,2B,3F,4B LV	5-6-0-3	N40105603 N40105629	N322556-003
P20A.005604	180	AC AC/DC	1F,2B HV 3F,4B LV	5-6-0-4	N40105604	N322556-004
P20A.005605	75	AC AC/DC	1F,2B HV 3F,4B LV	5-6-0-5	N40105605	N322556-005
P20A.005606	120	AC AC/DC	1F,2B HV 3F,4B LV	5-6-0-6	N40105606	N322556-006
P20A.005607	180	AC	1F,2B,3F,4B HV	5-6-0-7	N40105607	N322556-007
P20A.005608	75	AC	1F,2B,3F,4B HV	5-6-0-8	N40105608	N322556-008
P20A.005609	270	AC/DC	1F,2B,3F,4B LV	5-6-0-9	N40105609 N40105630	N322556-009
P20A.005610	270	AC	1F,2B,3F,4B HV	5-6-1-0	N40105610	N322556-010
P20A.005611	120	AC	1F,2B,3F,4B HV	5-6-1-1	N40105611	N322556-011
P20A.005612	75	AC	1F,2B,3F,4B HV	5-6-1-2	N40105612 N40105632	N322556-012
P20A.005613	120	AC	1F,2B,3F,4B HV	5-6-1-3	N40105613 N40105624	N322556-013
P20A.005614	180	AC	1F,2B,3F,4B HV	5-6-1-4	N40105614 N40105625	N322556-014
P20A.005616	420	AC	1F,2B,3F,4B HV	5-6-1-6	N40105616 N40105633	N322556-016
P20A.005617	50	AC	1F,2B,3F,4B HV	5-6-1-7	N40105617 N40105623	N322556-017
P20A.005618	75	AC/DC	1F,3F,2B,4B LV	5-6-1-8	N40105618	N322556-018 N322556-818
P20A.005619	270	AC AC/DC	1F,2B HV 3F,4B LV	5-6-1-9	N40105619	N322556-019
P20A.005621	50	AC/DC	1F,3F,2B,4B LV	5-6-2-1	N40105621 N40105627	N322556-021
P20A.005622	420	AC/DC	1F,3F,2B,4B LV	5-6-2-2	N40105622 N40105631	N322556-022


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4. INSTALLATION AND OPERATION

4.1. Replacement Installation Procedure

1. The PN-250CG directly replaces the PC-250 TR mechanical code generator in the existing base. No wiring or circuitry changes are required.

2. Ensure that the correct PN-250CG model is available for installation. Verify that the keying plate is correct for the code rate and model type. See Table 3-1 for available code rates, contact arrangements, and keying patterns.

WARNING

Never drill new holes in a base indexing plate, or change indexing pins on the back of a relay. Doing so will compromise the relay's keying integrity, resulting in a possible misapplication of the relay, and the functioning of the system in which it is used.

3. Remove the old relay.

4. Orient the PN-250CG to the existing base, with the nameplate right-side up. 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 into place.

4.2. New Installation

1. Secure the mounting base (N438689-003) directly to the rack using the hardware furnished with the mounting kit. Ensure that the base wiring is in accordance with wiring diagram for the specific job. General wiring guidelines are as follows:

   a. The new one-piece mounting base with hardware includes a full complement of receptacle contact springs (M451142-2702) that accommodates one or two #14 - #16 wires, mounting fasteners, and tags. However, the mounting base may also be equipped with receptacle contact springs for one or two #10 - #12 wires (M451142-2703), or for one or two #18 - #20 wires (M451142-2701). Determine which type of solderless receptacle contact springs accompany the mounting base before proceeding with the installation. See Table 4-1 for the proper crimping tool to use for each contact type.

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

   c. Receptacle contact springs must be inserted into the base with the lock side down.

CRIMPING TOOL AMP TYPE	WIRE SIZE	RECEPTACLE CONTACT SPRING
J397138	#10 - #12 AWG	M451142-2703
J397139	#14 - #16 AWG	M451142-2702
J397188	#18 - #20 AWG	M451142-2701

Table 4-1. Crimping Tools

d. Install wires in the receptacle contact springs in accordance with approved wiring diagrams. See Table 4-1 for the proper crimping tool to use for each contact type.

   1) Strip 3/16" of insulation from the end of the wire.

   2) Place the receptacle contact spring into the jaws of the crimping tool.

   3) Partially close the crimping tool jaws against the receptacle contact spring to hold it in place; do not fully crimp the contact spring barrel yet.

   4) Insert the stripped end of the wire all the way into the contact spring barrel. Squeeze the tool handle until crimping is completed and the jaws release. Always attach the first wire to the longest terminal. This ensures that a second lead can be attached to the receptacle contact spring later.

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

   6) After inserting the receptacle spring contact into the relay base, pull firmly on the wire to make sure it is locked in the cavity.

2. Orient the PN-250CG to the base, with the nameplate right-side up. 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 into place.

4.3. Verify Operation

1. Apply power and verify that the newly installed PN-250CG is operating by observing that the two LED indicators are blinking in an alternating fashion.

2. Verify that the PN-250CG, and the overall system, are functioning properly.

4.4. PN-250CG Dimensions

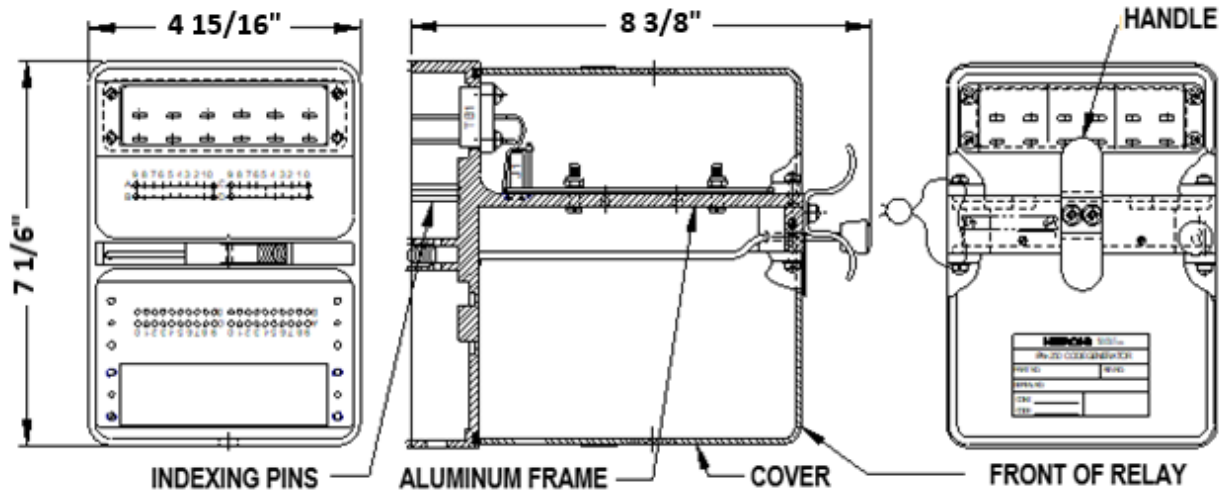

Figure 4-1. PN-250CG Relay Dimensions


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5. MAINTENANCE AND PERIODIC INSPECTION

The PN-250CG is a maintenance-free unit. There are no FRA requirements for periodic checking of solid-state code transmitter units. Periodic verification of the PN-250CG operation is at the customer's discretion.

Malfunctioning PN-250CG units should be returned to STS USA for repair.


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6. 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