g GE Energy	**Functional Testing Specification**
Parts & Repair Services ***Louisville, KY***	**LOU-GED-115D2227G4**

Test Procedure for a voltage comparator card 115D2227Gx series.

DOCUMENT REVISION STATUS: Determined by the last entry in the "REV" and "DATE" column

REV.	DESCRIPTION	SIGNATURE	REV. DATE
A	Transferred to new format	Glenn Chandler	06/14/13
B			
C			

PREPARED BY	REVIEWED BY	REVIEWED BY	QUALITY APPROVAL
Glenn Chandler			Charlie Wade
DATE	**DATE**	**DATE**	**DATE**
06/14/13			6/17/2013

1. SCOPE

1.1 This is a functional testing procedure for a voltage comparator card 115D2227Gx series.

2. STANDARDS OF QUALITY

2.1 Refer to the current revision of the IPC-A-610 standard for workmanship standards.

3. APPLICABLE DOCUMENTS

3.1 The following document(s) shall form part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue shall apply.
3.1.1 P3K-AL-0349-A01

4. ENGINEERING REQUIREMENTS

4.1 Equipment Cleaning
4.1.1 Equipment should be clean and free of debris prior to applying power unless performing an initial check. Refer to site specific SRA's for cleaning guidelines.
4.2 Equipment Inspection
4.2.1 Equipment should be visually inspected for any defects prior to applying power. This inspection should include the following as a minimum:
4.2.1.1 Wires - broken, cracked, or loosely connected
4.2.1.2 Terminal strips / connectors - broken or cracked
4.2.1.3 Components - visually damaged
4.2.1.4 Capacitors - bloated or leaking
4.2.1.5 Solder joints - damaged or cold
4.2.1.6 Circuit board - burned or de-laminated
4.2.1.7 Printed wire runs / Traces - burned or damaged

5. EQUIPMENT REQUIRED

5.1 The following equipment is required to perform the process requirements. Equipment may be substituted provided that all accuracy's and test ratios are equivalent or better.

Qty	Reference #	Description
1		Fluke 87 DMM (or Equivalent)
1		Dual Power Supply
1		Millivolt Source
1		Oscilloscope

6. Testing Procedure

6.1.1 Follow Procedure Below

P3K-AL-0349-A01 TEST INSTRUCTIONS FOR VOLTAGE COMPARATOR-STANDARD

CONT ON SHEET 2 SH NO. 1 FIRST MADE FOR EHC MARK II 115D2227

WITH REVISIONS FOR G4

(115D2227-G4) FIVE BOARDS WERE CHECKED FOR PRU ON 7/11/85 BY RPH. THE REF VOLTAGES HAD BE TO ±1.00 V. NO ADJUSTMENTS WERE MADE TO ANY BOARDS. ALL THE BOARDS CHECKED OUT PROPERLY TO TYPE A, B & C SPECIFICATIONS

I. SCOPE

This instruction outlines the test specifications for circuit board 115D2227. Groups 1, 2, and 3. (Schematics 115D2228, 133D6534, 137D5135 and 145D3820). *

II. CIRCUIT DESCRIPTION

This circuit is used for all voltage comparison functions in the Mark II system with the exception of the Power Load Unbalance, Early Valve Actuation, and Standby functions which have their own specialized voltage comparators.

Each circuit board contains two identical Voltage Comparator functions. The circuit, in general, looks at two input voltages and picks up a relay when one voltage exceeds the other in accordance with the following rules:

TYPE A * Relay (and LED) picks up when the voltage on Input #1 is more positive than the reference voltage which is connected on Input #2.

TYPE B * Relay (and LED) picks up when the voltage on Input #2 is more negative than the reference voltage which is connected on Input #1.

TYPE C * Relay (and LED) picks up when the voltage on Input #1 is more positive than the voltage on Input #2. (The internal reference voltage is not used in this case).

The relay contacts available per voltage comparator are two single pole double throw dry circuit contacts with 3.0 amp capacity at 28 VDC and resistance load.

Circuit Description:

This circuit, in general, consists of a high input impedance discrete component differential amplifier; an integrated circuit differential comparator; a transistor relay driver; a relay with bifilar coil and dry contacts; and a temperature compensated adjustable reference voltage with plus and minus capability.

A balance potentiometer is provided in the differential amplifier section so that the firing point can be adjusted exactly in spite of small component differences in each half of the amplifier. A hysteresis potentiometer is provided around the integrated circuit comparator to allow some adjustment of the difference between the pick-up point and drop-out point of the circuit. Having some hysteresis also prevents the relay from chattering if the input voltage is holding near the reference voltage. In order to improve noise immunity and to prevent false triggering on narrow pulses, two R-C filter networks have been included. One is on the input of the differential amplifier and the other is on the input of the integrated circuit differential comparator.

REVISIONS: 1980 MAY 6

MADE BY J. Polacek Sept. 14, 1977	APPROVALS	Steam Turbine DIV OR DEPT.	P3K-AL-0349-A01
ISSUED SEP 15 1977		Schenectady, N.Y. LOCATION	CONT ON SHEET 2 SH NO. 1

P3K-AL-0349-A01

CONT ON SHEET 3 SH NO. 2

TEST INSTRUCTIONS FOR VOLTAGE COMPARATOR-DIAGRAM

FIRST MADE FOR

REVISI

III. CIRCUIT SPECIFICATIONS

A. Power Supply Requirements

1. Power Supply 1: +22.000 ± 0.002 VDC
   Pin 37 at 150 ma
2. Power Supply 2: -22.000 ± 0.002 VDC
   Pin 41 at 60 ma

B. Input Signal Levels

1. VC1
   a. + Input (Pin 29) ± 15.0 VDC max.
   b. - Input (Pin 26) ± 15.0 VDC max.
2. VC2
   a. + Input (Pin 4) ± 15.0 VDC max.
   b. - Input (Pin 3) ± 15.0 VDC max.

C. Outputs

1. VC1
   a. Reference Voltage (Pin 24) adjustable by changing VR4 over the range ± 11.7 VDC with tolerance ± 5%. (12.28 - 11.12)
   b. Relay K1 Contacts
      1. K1-1 Pin ~~35~~ 34 Common
         Pin ~~38~~ 36 Normally Closed
         Pin ~~36~~ 35 Normally Open
      2. K1-2 Pin ~~34~~ 33 Common
         Pin 32 Normally Closed
         Pin 30 Normally Open
2. VC2
   a. Reference Voltage (Pin 2) adjustable by changing VR2 over the range ± 11.7 VDC with tolerance ± 5%.
   b. Relay K2 Contacts
      1. K2-1 Pin 12 Common
         Pin 16 Normally Closed
         Pin 14 Normally Open

PRINT

MADE BY J. Polacek Sept. 14, 1977 APPROVALS

ISSUED SEP 15 1977

Steam Turbine DIV OR DEPT.

Schenectady, N.Y. LOCATION

P3K-AL-0349-A01

CONT ON SHEET 3 SH NO. 2

CONT ON SHEET 4 SH NO. 3 FIRST MADE FOR

III. CIRCUIT SPECIFICATIONS (continued)

C. Outputs (continued)

2. VC2 (continued)

b. (continued)

2. K2-2, Pin 10 Common
Pin 8 Normally Closed
Pin 7 Normally Open

D. Performance Specifications

1. VC1

a. Set Balance Potentiometer (VR3)

1. Set up the following conditions:

Hysteresis adjust pot VR50 to max. CCW, + Input (Pin 29) to ground, - Input (pin 26) to ground. Monitor K1 relay contacts (Pin 35) and (pin 36) for continuity.
G4→ 35 36

2. Adjust VR3 until the relay K1 is just on the edge of picking up. (It may take several tries in order to get the exact point).

b. Check Operation Mode with Removed Inputs

1. Without inputs connected to pins 26 and 29, K1 relay should be energized. (0.Ω)

2. Apply +250mV to pin 26: K1 should de-energize. (∞Ω)

3. Remove the +250mV from pin 26: K1 should energize again.

4. Apply -250mV to pin 29: K1 should de-energize.

5. Remove the -250mV from pin 29: K1 should energize again.

6. If steps 1 or 3 or 5 fail to realize, turn VR3 slightly CW until K1 energizes. If steps 2 or 4 fail to realize, turn VR3 slightly CCW until K1 de-energizes. Repeat steps 1 through 5.

c. Check Reference Voltage (Pin 24)

1. Monitor Pin 24 with a digital voltmeter. Adjust VR4 over its entire range and verify that the voltage output is in accordance with Section III. C. 1. a. above. → ±11.7 Vdc

REVISED MAY 6 1980

MADE BY J. Polacek Sept. 14, 1977 APPROVALS ISSUED SEP 15 1977

Steam Turbine DIV OR DEPT. Schenectady, N.Y. LOCATION

P3K-AL-0349J-A01 CONT ON SHEET 4 SH NO. 3

CONT ON SHEET 5 SH NO. 4 FIRST MADE FOR

III. CIRCUIT SPECIFICATIONS (continued)

D. Performance Specifications (continued)

1. VC1 (continued)

d. Check Pick Up Point

1. Set up the following conditions for Type A operation:

Hysteresis adjust pot VR50 to max. CCW, +Input (Pin 29) to some adjustable external voltage, - Input (Pin 26) to reference voltage (Pin 24). Set reference voltage (Pin 24) to some convenient voltage between 0 and +10 VDC. Monitor K1 relay contacts (Pin 35) and (Pin 36) for continuity. Monitor the external voltage (Pin 29) with a digital voltmeter.

2. Slowly increase the external voltage (Pin 29) from some value below VREF and note its value where relay K1 picks up. This pickup voltage should be equal to the reference voltage on (Pin 26) within ± 30 mv. Several tries may be necessary to verify the pickup point. The relay must stay picked up as long as the external voltage (Pin 29) is more positive than the reference voltage on (Pin 26). To drop out the relay, the external voltage (Pin 29) must be reduced below the reference voltage (Pin 26).

3. Repeat steps 1 and 2 with the reference voltage (Pin 24) set to some convenient voltage between 0 and -10 VDC.

e. Check Relay Contacts

1. Set up conditions for Step III. D. 1. d. above.

2. Monitor K1-1 and K1-2 relay contacts for continuity.

3. Pickup and drop out relay K1 and verify that all contacts will open and close.

f. Check Hysteresis - Low End

1. Set up conditions for Step III. D. 1. d. above.

2. Set potentiometer VR50 to max. CCW.

3. Pick up and drop out relay K1. Monitor the external voltage on (Pin 29) where the relay picks up and drops out. The difference in voltage between pick up and drop out must be less than 80 mv.

MADE BY J. Polacek Sept. 14, 1977 | APPROVALS | Steam Turbine DIV OR DEPT. | P3K-AL-0349-A01

ISSUED SEP 19 1977 | Schenectady, N.Y. LOCATION | CONT ON SHEET 5 SH NO.

CONT ON SHEET 6 SH NO. 5 FIRST MADE FOR

III. CIRCUIT SPECIFICATIONS (continued)

D. Performance Specifications (continued)

1. VC1 (continued)

g. Check Hysteresis - High End

1. Set up conditions for Step III. D. 1. d. above.

2. Set potentiometer VR50 to max. CW.

3. Pick up and drop out relay K1. Monitor the external voltage on (Pin 29) where the relay picks up and drops out. The difference in voltage between pickup and drop out must be greater than 125 mv.

h. Check Pickup Time

1. Set up the following conditions for Type A operation: Hysteresis adjust pot VR50 to max. CCW, + Input (Pin 29) to a voltage source and switch (S1) such that this input can be switched from 0V to +5V, - Input (Pin 26) to reference voltage (Pin 24). Set reference voltage (Pin 24) to 1.0 V. Monitor DC voltage source of nominally 24 VDC through the K1-1 normally open relay contacts with an oscilloscope. Trigger the oscilloscope with the output of external switch S1.

2. Close S1 and observe on the oscilloscope the time it takes for relay contacts K1-1 to close. The pickup time must be less than 10 ms.

i. Check Drop Out Time

1. This test can be performed at the same time as III. D. 1. h. above with the same set up.

2. Open switch S1 and observe on the oscilloscope the time it takes for relay contacts K1-1 to open. The drop out time must be less than 34 ms.

2. VC2

a. Set Balance Potnetiometer (VR1)

1. Set up the following conditions:

Hysteresis adjust pot VR51 to max. CCW, + Input (Pin 4) to ground, - Input (Pin 3) to ground. Monitor K2 relay contacts (Pin 12) and (Pin 14) for continuity.

MADE BY J. Polacek Sept. 14, 197 APPROVALS Steam Turbine DIV OR DEPT. P3K-AL-0349-A01

ISSUED SEP 15 1977 Schenectady, N.Y. LOCATION CONT ON SHEET 6 SH NO.

CONT ON SHEET 7 SH NO. 6 FIRST MADE FOR

III. CIRCUIT SPECIFICATIONS (continued)

D. Performance Specifications (continued)

2. VC2 (continued)

a. (continued)

27 2. Adjust VR1 until the relay K2 is just on the edge of picking up. (It may take several tries in order to get the exact point).

b. Check Operation Mode with Removed Inputs

28 1. Without inputs connected to pins 3 and 4, K2 relay should be energized.

29 2. Apply +250mV to pin 3: K2 should de-energize.

30 3. Remove the +250mV from pin 3: K2 should eneregize again.

31 4. Apply -250mV to pin 4: K2 should de-energize.

32 5. Remove the -250mV from pin 4: K2 should energize again.

33 6. If steps 1 or 3 or 5 fail to realize, turn VR1 slightly CW until K2 energizes. If steps 2 or 4 fail to realize, turn VR1 slightly CCW until K2 de-energizes. Repeat steps 1 through 5.

c. Check Reference Voltage (Pin 2)

34 1. Monitor Pin 2 with a digital voltmeter. Adjust VR2 over its entire range and verify that the voltage output is in accordance with Section III. C. 2. a. above. ±11.7 Vdc

d. Check Pick Up Point

35 1. Set up the following conditions for Type A operation:

Hysteresis adjust pot VR51 to max. CCW, + Input (Pin 4) to some adjustable external voltage, - Input (Pin 3) to reference voltage (Pin 2). Set reference voltage (Pin 2) to some convenient voltage between 0 and +10 VDC. Monitor K2 relay contacts (Pin 12) and (Pin 14) for continuity. Monitor the external voltage (Pin 4) with a digital voltmeter.

REV: 1 PAULIAN MAY 6 1980; 2

MADE BY	APPROVALS		DIV OR DEPT.	
J. Polacek Sept. 14, 1977		Steam Turbine		P3K-AL-0349-A01
ISSUED SEP 15 1977		Schenectady, N.Y.	LOCATION	CONT ON SHEET 7 SH NO.

PF-803-WA (9-74) CODE

CONT ON SHEET 8 SH NO. 7 FIRST MADE FOR

III. CIRCUIT SPECIFICATIONS (continued)

D. Performance Specifications (continued)

2. VC2 (continued)

d. (continued)

2. Slowly increase the external voltage (Pin 4) from some value below VREF and note its value where relay K2 picks up. This pick up voltage should be equal to the reference voltage on (Pin 3) within ± 30 mv. Several tries may be necessary to verify the pcik up point. The relay must stay picked up as long as the external voltage (Pin 4) is more positive than the reference voltage on (Pin 3). To drop out the relay, the external voltage (Pin 4) must be reduced below the reference voltage (Pin 3).

3. Repeat steps 1 and 2 with the reference voltage (Pin 2) set to some convenient voltage between 0 and -10 VDC.

e. Check Relay Contacts

1. Set up conditions for Step III. D. 2. d. above.

2. Monitor K2-1 and K2-2 relay contacts for continuity.

3. Pick up and drop out relay K2 and verify that all contacts will open and close.

K2-1 C-12 NC-16 NO-14

K2-2 C 10 NC 8 NO 7

REVI

PRI

MADE BY J. Polacek Sept. 14, 1977 APPROVALS Steam Turbine DIV OR DEPT. P3K-AL- 0348-A01

ISSUED 0 SEP 16 1977 Schenectady, N.Y. LOCATION CONT ON SHEET 8 SH NO.

P3K-AL- 0349-A01
CONT ON SHEET 9 SH NO. 8 FIRST MADE FOR

III. CIRCUIT SPECIFICATIONS (Con't)

D. Performance Specifications (Con't)

2. VC2

f. Check Hysteresis - Low End

1. Set up conditions for Step III. D. 2. d. above.

2. Set potentiometer VR51 to max. CCW.

3. Pick up and drop out relay K2. Monitor the external voltage on (Pin 4) where the relay picks up and drops out. The difference in voltage between pick up and drop out must be less than 80 mv.

g. Check Hysteresis - High End

1. Set up conditions for Step III. D. 2. d. above.

2. Set potentiometer VR51 to max. CW.

3. Pick up and drop out relay K2. Monitor the external voltage on (Pin 4) where the relay picks up and drops out. The difference in voltage between pick up and drop out must be greater than ~~150~~ 100 mv. D193 mv.

h. Check Pick Up Time

1. Set up the following conditions for Type A operation:

Hysteresis adjust pot VR51 to max. CCW, + Input (Pin 4) to a voltage source and switch (S1) such that this input can be switched from 0V to +5V. - Input (Pin 3) to reference voltage (Pin 2). Set reference voltage (Pin 2) to +1.0 V. Monitor a D.C. voltage source of nominally 24 VDC through the K2-1 normally open relay contacts with an oscilloscope. Trigger the oscilloscope with the output of external switch S1.

2. Close S1 and observe on the oscilloscope the time it takes for relay contacts K2-1 to close. The pick up time must be less than 18 ms.

i. Check Drop Out Time

1. This test can be performed at the same time as III. D. 2. g. above with the same set up.

2. Open switch S1 and observe on the oscilloscope the time it takes for relay contacts K2-1 to open. The drop out time must be less than 34 ms.

IV. SET POINTS

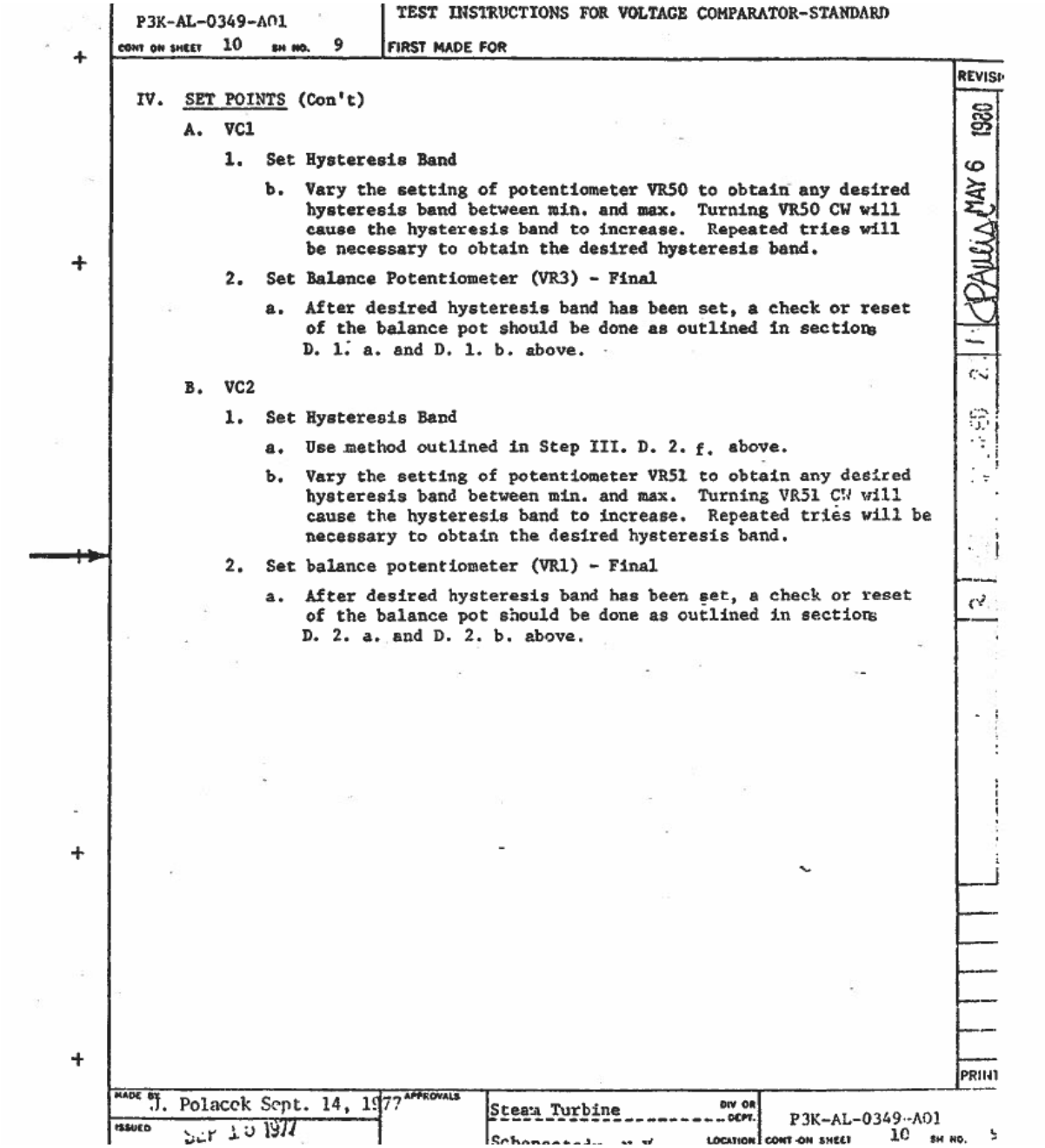
A. VC1

1. Set Hysteresis Band

a. Use method outlined in Step III. D. 1. f. above.

REVISIC ... PAllisi MAY 6 ... FEB 2 ... PRINT

MADE BY J. Polacek Sept. 14, 1977 APPROVALS | Steam Turbine DIV OR DEPT. | P3K-AL-0349-A01
ISSUED MAY 10 1977 | Schenectady N.Y. LOCATION | CONT ON SHEET 9 SH NO. 8



P3K-AL-0349-A01
CONT ON SHEET 10 SH NO. 9

TEST INSTRUCTIONS FOR VOLTAGE COMPARATOR-STANDARD
FIRST MADE FOR

REVISI

IV. SET POINTS (Con't)

A. VC1

1. Set Hysteresis Band

b. Vary the setting of potentiometer VR50 to obtain any desired hysteresis band between min. and max. Turning VR50 CW will cause the hysteresis band to increase. Repeated tries will be necessary to obtain the desired hysteresis band.

2. Set Balance Potentiometer (VR3) - Final

a. After desired hysteresis band has been set, a check or reset of the balance pot should be done as outlined in sections D. 1. a. and D. 1. b. above.

B. VC2

1. Set Hysteresis Band

a. Use method outlined in Step III. D. 2. f. above.

b. Vary the setting of potentiometer VR51 to obtain any desired hysteresis band between min. and max. Turning VR51 CW will cause the hysteresis band to increase. Repeated tries will be necessary to obtain the desired hysteresis band.

2. Set balance potentiometer (VR1) - Final

a. After desired hysteresis band has been set, a check or reset of the balance pot should be done as outlined in sections D. 2. a. and D. 2. b. above.

MAY 6 1980 PAULIA

PRINT

MADE BY J. Polacek Sept. 14, 1977 APPROVALS
ISSUED Sep 15 1977
Steam Turbine DIV OR DEPT.
LOCATION
P3K-AL-0349-A01
CONT ON SHEET 10 SH NO.

6.2 ***TEST COMPLETE ***

7. Notes

7.1 None at this time.