



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

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

<p>LOU-GED-115D2227G4 REV. A</p>	<p>g</p> <p>GE Energy Parts & Repair Services Louisville, KY</p>	<p>Page 2 of 11</p>
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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		FIRST MADE FOR EHC MARK II		115D2227	
CONT ON SHEET 2		SH NO. 1		WITH REVISIONS FOR G4	
<p>I. SCOPE</p> <p>This instruction outlines the test specifications for circuit board 115D2227. Groups 1, 2, and 3. (Schematics 115D2228, 133D6534, 137D5135 and 145D3820).</p> <p>II. CIRCUIT DESCRIPTION</p> <p>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.</p> <p>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:</p> <p>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.</p> <p>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.</p> <p>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).</p> <p>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.</p> <p>Circuit Description:</p> <p>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.</p> <p>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.</p>					
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COPYRIGHT 1983 GENERAL ELECTRIC CO.		<p>MADE BY J. Polacek Sept. 14, 1977</p> <p>ISSUED SEP 15 1977</p> <p>APPROVALS</p> <p>Steam Turbine DEPT. P3K-AL-0349-A01</p> <p>Schenectady, N.Y. LOCATION CONT ON SHEET 2 SH NO. 1</p>			

<p>P3K-AL-0349-A01</p> <p>CONT ON SHEET 3 SH NO. 2</p>	<p>TEST INSTRUCTIONS FOR VOLTAGE DETECTION - PARTIAL</p> <p>FIRST MADE FOR</p>																								
<p>III. CIRCUIT SPECIFICATIONS</p>																									
<p>A. Power Supply Requirements</p> <p>1. Power Supply 1: $+22.000 \pm 0.002$ VDC Pin 37 at 150 ma</p> <p>2. Power Supply 2: -22.000 ± 0.002 VDC Pin 41 at 60 ma</p>																									
<p>B. Input Signal Levels</p> <p>1. VC1</p> <p>a. + Input (Pin 29) ± 15.0 VDC max. b. - Input (Pin 26) ± 15.0 VDC max.</p> <p>2. VC2</p> <p>a. + Input (Pin 4) ± 15.0 VDC max. b. - Input (Pin 3) ± 15.0 VDC max.</p>																									
<p>C. Outputs</p> <p>1. VC1</p> <p>a. Reference Voltage (Pin 24) adjustable by changing VR4 over the range ± 11.7 VDC with tolerance $\pm 5\%$. (12,28 - 11,12)</p> <p>b. Relay K1 Contacts</p> <table style="margin-left: 40px;"> <tr> <td>1. K1-1</td> <td>Pin 35 Common</td> <td>34</td> </tr> <tr> <td></td> <td>Pin 98 Normally Closed</td> <td>36</td> </tr> <tr> <td></td> <td>Pin 36 Normally Open</td> <td>35</td> </tr> <tr> <td>2. K1-2</td> <td>Pin 34 Common</td> <td>33</td> </tr> <tr> <td></td> <td>Pin 32 Normally Closed</td> <td>32</td> </tr> <tr> <td></td> <td>Pin 30 Normally Open</td> <td>30</td> </tr> </table> <p>2. VC2</p> <p>a. Reference Voltage (Pin 2) adjustable by changing VR2 over the range ± 11.7 VDC with tolerance $\pm 5\%$.</p> <p>b. Relay K2 Contacts</p> <table style="margin-left: 40px;"> <tr> <td>1. K2-1</td> <td>Pin 12 Common</td> </tr> <tr> <td></td> <td>Pin 16 Normally Closed</td> </tr> <tr> <td></td> <td>Pin 14 Normally Open</td> </tr> </table>		1. K1-1	Pin 35 Common	34		Pin 98 Normally Closed	36		Pin 36 Normally Open	35	2. K1-2	Pin 34 Common	33		Pin 32 Normally Closed	32		Pin 30 Normally Open	30	1. K2-1	Pin 12 Common		Pin 16 Normally Closed		Pin 14 Normally Open
1. K1-1	Pin 35 Common	34																							
	Pin 98 Normally Closed	36																							
	Pin 36 Normally Open	35																							
2. K1-2	Pin 34 Common	33																							
	Pin 32 Normally Closed	32																							
	Pin 30 Normally Open	30																							
1. K2-1	Pin 12 Common																								
	Pin 16 Normally Closed																								
	Pin 14 Normally Open																								
<p>PRINT</p>																									
<p>MADE BY J. Polacek Sept. 14, 1977</p> <p>ISSUED SEP 15 1977</p>	<p>APPROVALS</p> <p>Steam Turbine</p> <p>Schenectady, N.Y.</p>																								
<p>DIV OR DEPT. P3K-AL-0349-A01</p> <p>LOCATION CONT ON SHEET 3 SH NO. 2</p>																									

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.

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. (0.2)
2. Apply +250mV to pin 26: K1 should de-energize. (0.2)
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. $\rightarrow \pm 11.7Vdc$

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APPROVALS

Steam Turbine

Schenectady, N.Y.

DIV OR

DEPT.

P3K-AL-03491-A01

LOCATION

CONT ON SHEET

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SH NO. 3

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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 Potentiometer (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.

CONT ON SHEET	7	SH NO.	6	FIRST MADE FOR	
<p>III. <u>CIRCUIT SPECIFICATIONS</u> (continued)</p> <p>D. Performance Specifications (continued)</p> <p>2. VC2 (continued)</p> <p>a. (continued)</p> <p>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).</p> <p>b. Check Operation Mode with Removed Inputs</p> <p>1. Without inputs connected to pins 3 and 4, K2 relay should be energized.</p> <p>2. Apply +250mV to pin 3: K2 should de-energize.</p> <p>3. Remove the +250mV from pin 3: K2 should energize again.</p> <p>4. Apply -250mV to pin 4: K2 should de-energize.</p> <p>5. Remove the -250mV from pin 4: K2 should energize again.</p> <p>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.</p> <p>c. Check Reference Voltage (Pin 2)</p> <p>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. <u>11.7 vdc</u></p> <p>d. Check Pick Up Point</p> <p>1. Set up the following conditions for Type A operation:</p> <p>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.</p>					REV
<p>MADE BY J. Polacek Sept. 14, 1977</p> <p>ISSUED SEP 15 1977</p> <p>APPROVALS</p> <p>Steam Turbine</p> <p>Schenectady, N.Y.</p> <p>DIV OR DEPT.</p> <p>LOCATION</p> <p>P3K-AL-0349-A01</p> <p>CONT ON SHEET 7</p> <p>SH NO.</p> <p>CODE</p>					<p>REV</p> <p>11 KPAUL MAY 6 1980</p> <p>12</p> <p>PR</p>

CONT ON SHEET	8	SH NO. 7	FIRST MADE FOR
<p>III. <u>CIRCUIT SPECIFICATIONS</u> (continued)</p> <p>D. Performance Specifications (continued)</p> <p>2. VC2 (continued)</p> <p>d. (continued)</p> <p>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 pick 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).</p> <p>3. Repeat steps 1 and 2 with the reference voltage (Pin 2) set to some convenient voltage between 0 and -10 VDC.</p> <p>e. Check Relay Contacts</p> <p>1. Set up conditions for Step III. D. 2. d. above.</p> <p>2. Monitor K2-1 and K2-2 relay contacts for continuity.</p> <p>3. Pick up and drop out relay K2 and verify that all contacts will open and close.</p>			
<p>MADE BY J. Polacek Sept. 14, 1977</p> <p>ISSUED 8 SEP 16 1977</p> <p>APPROVALS</p> <p>Steam Turbine</p> <p>Schenectady, N.Y.</p> <p>DIV OR DEPT.</p> <p>LOCATION</p> <p>P3K-AL-0349-A01</p> <p>CONT ON SHEET 8</p> <p>SH NO.</p>			

P3K-AL-0349-A01		FIRST MADE FOR		REVISION
CONT ON SHEET	SH NO.			
9	8			
<p>III. <u>CIRCUIT SPECIFICATIONS</u> (Con't)</p> <p>D. Performance Specifications (Con't)</p> <p>2. VC2</p> <p>f. Check Hysteresis - Low End</p> <ol style="list-style-type: none"> Set up conditions for Step III. D. 2. d. above. Set potentiometer VR51 to max. CCW. 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. <p>g. Check Hysteresis - High End</p> <ol style="list-style-type: none"> Set up conditions for Step III. D. 2. d. above. Set potentiometer VR51 to max. CW. 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 mv. <p>h. Check Pick Up Time</p> <ol style="list-style-type: none"> 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. 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. <p>i. Check Drop Out Time</p> <ol style="list-style-type: none"> This test can be performed at the same time as III. D. 2. g. above with the same set up. 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. 				<p>1304</p> <p>MAY 6</p> <p>FEB 2</p> <p>2</p>
<p>IV. <u>SET POINTS</u></p> <p>A. VC1</p> <ol style="list-style-type: none"> Set Hysteresis Band <p>a. Use method outlined in Step III. D. 1. f. above.</p>				
<p>MADE BY J. Polacek Sept. 14, 1977</p> <p>ISSUED 10 1977</p>		<p>APPROVALS</p> <p>Steam Turbine</p> <p>Schenectady N.Y.</p>		<p>DIV OR DEPT.</p> <p>P3K-AL-0349-A01</p> <p>LOCATION</p> <p>CONT ON SHEET 9 SH NO. 8</p>

P3K-AL-0349-A01		TEST INSTRUCTIONS FOR VOLTAGE COMPARATOR-STANDARD	
CONT ON SHEET 10	SH NO. 9	FIRST MADE FOR	
<p>IV. <u>SET POINTS</u> (Con't)</p> <p>A. VC1</p> <ol style="list-style-type: none"> Set Hysteresis Band <ol style="list-style-type: none"> 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. Set Balance Potentiometer (VR3) - Final <ol style="list-style-type: none"> 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. <p>B. VC2</p> <ol style="list-style-type: none"> Set Hysteresis Band <ol style="list-style-type: none"> Use method outlined in Step III. D. 2. f. above. 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. Set balance potentiometer (VR1) - Final <ol style="list-style-type: none"> 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. 			<p>REVISI</p> <p>1980</p> <p>PAULA MAY 6</p> <p>1</p> <p>2</p> <p>3</p> <p>4</p> <p>5</p> <p>6</p> <p>7</p> <p>8</p> <p>9</p> <p>10</p> <p>11</p> <p>12</p> <p>13</p> <p>14</p> <p>15</p> <p>16</p> <p>17</p> <p>18</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p> <p>26</p> <p>27</p> <p>28</p> <p>29</p> <p>30</p> <p>31</p> <p>32</p> <p>33</p> <p>34</p> <p>35</p> <p>36</p> <p>37</p> <p>38</p> <p>39</p> <p>40</p> <p>41</p> <p>42</p> <p>43</p> <p>44</p> <p>45</p> <p>46</p> <p>47</p> <p>48</p> <p>49</p> <p>50</p> <p>51</p> <p>52</p> <p>53</p> <p>54</p> <p>55</p> <p>56</p> <p>57</p> <p>58</p> <p>59</p> <p>60</p> <p>61</p> <p>62</p> <p>63</p> <p>64</p> <p>65</p> <p>66</p> <p>67</p> <p>68</p> <p>69</p> <p>70</p> <p>71</p> <p>72</p> <p>73</p> <p>74</p> <p>75</p> <p>76</p> <p>77</p> <p>78</p> <p>79</p> <p>80</p> <p>81</p> <p>82</p> <p>83</p> <p>84</p> <p>85</p> <p>86</p> <p>87</p> <p>88</p> <p>89</p> <p>90</p> <p>91</p> <p>92</p> <p>93</p> <p>94</p> <p>95</p> <p>96</p> <p>97</p> <p>98</p> <p>99</p> <p>100</p>
MADE BY J. Polacek Sept. 14, 1977	ISSUED SEP 15 1977	APPROVALS	<p>Steam Turbine</p> <p>DEPT. P3K-AL-0349-A01</p> <p>LOCATION CONT ON SHEET 10 SH NO. 9</p>

6.2 ***TEST COMPLETE***

7. Notes

7.1 None at this time.