Type KD Compensator Distance Relays Calibration and Maintenance Procedures

Effective: April 1981
NEW INFORMATION

These instructions are intended to supplement Instruction Leaflets 41-491, 41-498.11, 41-491.4, 41-498.12 and 41-490, covering the KD-1 4, 41, 5, 10, and 11 line of compensator distance relays, respectively. These instructions expand on the information given in these I.L.'s and suggest what elements should be included in a calibration and maintenance program.

A calibration and maintenance program should involve two steps: 1) a receiving acceptance check and 2) a routine (periodic) maintenance program. These two steps are outlined below:

1.0 RECEIVING ACCEPTANCE

Received relays should be subjected to the checks outlined in the applicable I.L. These checks will insure that there is no shipping damage and that the relay has been received in the same calibrated condition as it left the factory. They will insure that set-up procedures such as removing contact blocking has been accomplished. A receiving acceptance check should include the following steps:

1. Perform all of the mechanical and electrical tests listed in the receiving acceptance section of the applicable I.L., include the maximum torque angle test, even if it is not called for in some I.L.'s

2. .Follow the appropriate test procedures outlined in I.L.'s covering the K-DAR FIELD TEST UNIT. It is suggested that all dial test readings in each test be recorded for future reference. This information will be very helpful in recognizing possible drift of electrical characteristics.

3. If the settings to be applied to the relay when it is installed are known, the relay should be set to these settings and checked with the field test units as noted in step 2 above. A record for future reference should be taken. The relay test values using the KDAR test unit should check to be within 27 percent of the relay settings.

2.0 ROUTINE MAINTENANCE

The relay should be checked periodically at time intervals dictated by previous experience and practices. Westinghouse recommends that the time interval between checks be a maximum of two years. Routine maintenance should include at least the following steps:

1. Repeat step 2 or 3 under Receiving Acceptance and record test results.

2. Compare test results with previous results. If any test values deviate from previous checks by more than ±5 percent, recheck relay performance in line with the receiving acceptance checks outlined above step 1.

3. Retain records of test results on each particular relay. During each routine maintenance, the records should be analyzed to determine if there is any evidence of drift; i.e., continued change in characteristic in the same direction. Evidence of drift should be traced to the particular element involved, usually a capacitor or resistor and this element replaced.

All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding this particular installation, operation or maintenance of this equipment, the local ABB representative should be contacted.

4. Some of the more common component problems may be detected as follows:

   With the relay mounted on a panel and energized by station C. T.'s & P. T.'s, open all trip circuits and all current switch positions 12, 13, 14, 16, 17, 18, 19, and phase C voltage switches (terminal 9) and if applicable in additional switch position on the separately-energized 38 unit. Check the internal schematic for your particular relay. Jumper terminal 7 to terminal 9 and to any other applicable switch normally connected to phase C, on the relay side (upper half of the switch). The contacts of both operating units should stay open. If the 3-phase unit contact closes, it indicates misadjustment of resistor, R3A, or potentiometer, P3A (most common cause), or a defective capacitor, C3C, follow the instructions for troubleshooting in Section E for KD-4 and KD-5 relays and the proper instruction leaflet for KD, KD-1 and KD-10 and KD-11 relays.

   If phase-to-phase unit closes, recheck for:

KD & KD-1 relays	R_{MA} & R_{MC}-Calibration
KD-4 KD-5 & KD-41 relay	R_{AC}-Calibration
KD-10 & KD-11	X_{LAX}-Adjustment

3.0 CALIBRATION AND TROUBLE SHOOTING HINTS:

A. Experience has shown that calibration of the relay for maximum torque angle is the procedure most susceptible to error. Two potential sources of error are most common.

   1. Instrumentation errors - Be sure of the accuracy of calibration of all instruments and phase shifters used. Instruments should be chosen and ranges selected so that readings are taken with the instrument reading in the top third of the scale.

      When a phase shifter is used, attention should be paid to the fact that voltage and current settings will change as the angle is varied. To avoid inaccuracites due to this effect, check the voltage and current settings when contact operation indicates that maximum torque angle check point has been reached.

   2. Failure or miscalibration of components not connected with angle adjustment to distinguish between the two sources of error it is recommended to perform compensator nulling test as follows:

B. **For KD4, 41, 5, 10 and 11 relays**

   Phase-to-phase unit (T_{AB} and T_{BC} compensators) Maximum Sensitivity Angle

   1. Use "PH-PH-1-2 Phase Test" - connection for T_{AB}-compensator, and "PH-PH-2-3" Test connection for T_{BC} compensator. Refer to the figure in the I.L. titled "Test Connections."

   2. Measure voltage across C_{2A} for T_{AB} and across C_{2C} for T_{BC}.

   3. Set current equal to:

$$\frac{V1F2F}{RELAY\ \ SETTING}$$

      The current should be high enough to provide an accurate phase angle meter reading, or any convenient value if a phase-shifter is used for direct angle reading.

   4. Set the phase shifter for the desired maximum torque angle value.

      Note the voltage.

   5. Vary the phase angle in both directions of the set value, to see that a low voltage (below 1 volt, to see that a low voltage (below 1 volt) is obtained at the maximum torque angle setting. If within ±2 degrees, it can be left undisturbed. If the minimum voltage is obtained at some other angle, readjust phase shifting resistor or potentiometer at the desired angle.

C. For KD and KD-1 Relays

   Follow procedure above except:

   1. For T_a compensator, use connection #2, omit voltage connection to terminal 9, disconnect L_A-lead, insert voltmeter to measure open circuit voltage and use twice the current value obtained for KD-10 tests. Follow

procedure outlined above except adjust R_{2A} when required.

2. For T_B compensator, use procedure outlined above, except use #3 connection and adjust R_{2B} when required.

3. For T_C compensator, use connection #4, omit voltage connection to terminal 7, disconnect L_C-lead, and adjust R_{2C} when required as per Part 1.

D. **Three-phase unit (T compensator) of all KD type relays:**

1. Use connection #1.

2. Measure Voltage across C_{3A}

3. Set the current equal to:

$$\frac{V1F2F}{1.5 \text{ Relay Setting}}$$

The current should be high enough to provide an accurate phase angle meter reading, or any convenient value if a phase-shifter is used for direct angle reading.

4. Set the phase-shifter for the desired maximum torque angle value.

Note the voltage.

5. Vary phase angle in both directions of the set value, to see that a low voltage (below 1 volt) is obtained at the maximum torque angle setting. If minimum voltage is within ±2 degrees, do not readjust. If the minimum voltage is obtained at some other angle readjust phase-shifting resistor or potentiometer at the desired angle.

E. Suggested Procedure for Detecting and Replacing Defective C_{3C} Capacitor

Step 1

Set S = 1 for the 3-phase unit

Apply approximately 120 volts to relay terminal 7 and 8 and short out terminals 7 and 9 (for KD-5 between terminals 6 and 9 and some short reach KD-4).

If contacts of the 3-phase unit close, then, the C_{2C} capacitor is under suspicion by improperly adjusted R3A can be suspected, as well.

Step 2

Remove the connections made in Step 1.

Apply approximately 120 volts (i.e., 100-130 volts) to: terminals 8 and 9 = V_{89}.

Measure the voltage across the C_{3C} capacitor with a high impedance voltmeter - 5000 OHMS/volt.

For .75-20 OHM reach KD-4 relays, the minimum voltage should be Vmin = 3.72 x V_{89}. If Vmin less than 3.72 x V_{89} replace capacitor C_{3C}.

For .24-35 OHM reach KD4 and KD-5 relays, the minimum voltage should be Vmin = 2.82 x V_{89} if Vmin less than 2.82 x V_{89}, replace capacitor C_{3C}.

For all ranges KD-10 use same procedure as for .75-20 OHM reach.

Step 3

Relays which fail either step 1, or have C_{3C} capacitor replaced after failing step 2, or after C_{2A} capacitor is replaced, require readjustment of R_{3A} or P_{3A}. Repeat step 1 and adjust R_{3A} or P_{2A} so that contacts just open.

Measure total R_{3F} and R_{3A} resistance

Omit this procedure for KD-10 relays.

a) for .75-20 OHM reach KD-4 relays

- when the relay is preheated as per I.L., decrease R_{3A} setting by 10% of total R_{3F} and R_{3A} resistance.

or • for a cold relay repeat step 1 and adjust R_{3A} so that the contact just opens. No further adjustment is required.

b) for .2-4.35 OHM reach KD-4 relays with sub “A” in the style number

•) for a cold relay, decrease R_{3A} setting 8% of total R_{3A} + R_{3F} resistance.

- For a hot relay, decrease R_{3A} setting 8% of total R_{3A} + R_{3F} resistance.

c) for .2-4.35 OHM relays without sub "A" in style number

- for a cold relay, decreases R3A setting 7% of total R_{3A} + R_{3F} resistance.
- for a hot relay, decrease R_{3A} setting 4% of total R_{3A} + R3F resistance.

NOTE: R_{3A} range of adjustment may occasionally be insufficient. If so, set R_{3F} for maximum resistance, or replace R_{3F} resistor with higher value.

d) For KD-10 follow instruction leaflet to adjust R_{3A} or P_{3A}.

F) Suggested procedure for C_{3C} for KD-1, KD-41, KD-11 relays.

a) No voltage test is required across the C_{3C} capacitor.

b) If C_{3C} has been found bad (shorted or leaky) repeat P_{3A} or R_{3A} adjustment above.

G. Suggested Procedure for Replacement of C_{2C}, C_{2A} Capacitors

After the capacitors have been replaced:

a) Open relay switch 9 (phase C potential)

b) short terminals 7 and 9 on relay side and apply approximately 120 volts to terminals 7 and 8.

c) adjust R_{CA} resistor for KD-4-41 relays and XLAC for KD-10-11 relays so contact just floats - favoring contact opening direction.

d) if desired, repeat 2.5 volts calibration point.

e) for KD and KD-1 relays, follow procedure for R_{MA} & R_{MC} calibration.

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