7SG11 Argus 7

Check and System Synchronising Relays

Document Release History

This document is issue 2010/02 The list of revisions up to and including this issue is:
Pre release

2010/02	Document reformat due to rebrand

Software Revision History

Contents

1 REQUIRED TEST EQUIPMENT

The following equipment will be required to perform commissioning tests on the Argus 7 relay.

- 500V Insulation resistance test set.
- Two variable A.C. voltage sources with a means of varying the phase relationship between them e.g. phase shifting transformer. Ideally, a portable relay test set e.g. Doble, Omicron etc.
- Time interval meter.
- Two A.C. Voltmeters.
- Phase angle meter.
- D.C. supply with nominal voltage within the working range of the relay's D.C. auxiliary supply rating.
- D.C. supply with nominal voltage within the working range of the relay's D.C. status input rating.
- Continuity tester e.g. multimeter.

Additional equipment for testing the communications channel :

- Portable PC with an electrical-to-optical RS232 converter and fibre optic connectors.
- A copy of Reydisp Evolution software installed on the PC to exercise the communications channel.

2 INSPECTION

Check that the relay has not been damaged in any way since being installed into the panel. Remove the relay from the case and check that the serial numbers of the relay and the case are all identical. Check also that the relay is the correct model and that the rating is correct. Ensure that all connections are tight and in accordance with the relay wiring diagram or the scheme diagram. Replace the relay back into the case and check that it is fully inserted. Ensure that the relay case is solidly bonded to a local earth point by checking the earthing connection to the case.

3 APPLYING SETTINGS

Before applying settings to the relay the engineers should take time out to familiarise themselves with the relay's menu system. Section 1 and section 3 of this manual are helpful in this respect. The relay settings for the particular application should be applied before any secondary testing occurs. If they are not available then the relay has default settings which can be used for pre-commissioning tests. See section 3 of this manual for a list of the relay default settings.

Settings can be entered into the relay using the keypad on the front of the relay or they can be sent to the relay, from a file, using a portable PC and Reydisp Evolution software package. Argus 7 relays feature eight alternative setting groups. In applications where more than one setting group is to be used then it may be necessary to test the relay in more than one configuration.

Note :- one settings group may be used to retain test settings.

When using setting groups it is important to remember that the relay may not necessarily be operating from the settings which are currently being displayed. There is an 'Active Settings Group' on which the relay operates and a 'Settings Group Edit/View' which allows the settings in one group to be viewed and altered while protection continues to operate on a different unaffected group. The 'Active Settings Group' and the 'Settings Group Edit/View' are selected in the System Configuration Menu. Settings should not be altered in the 'Active Settings Group' while the relay is in service unless other precautions, such as removing system links to prevent operation, are taken.

4 PRECAUTIONS

Before testing commences the relay should be isolated from the voltage transformers in line with the local site procedures. The closing and alarm circuits should also be isolated where practical. Ensure that the correct d.c. auxiliary voltage is applied to the circuit. See the relevant scheme diagrams for the relay connections.

5 TESTS

5.1 Insulation

When required, insulation tests to check the relay and associated wiring can be performed using a 500V electronic insulation resistance test set. The wiring may be tested between :-

1. All electrically isolated circuits.
2. All circuits to earth.

Accessible terminals of the same circuit should be connected together and deliberate circuit earthing links removed for the tests. Normal connections must be restored after testing. Satisfactory values for the various readings above depend upon the amount of wiring concerned. Where considerable multi-core wiring is involved a reading of 2.5 to 3.0 MΩ can be considered satisfactory. For short lengths of wiring higher values can be expected. A value of 1.0 MΩ should not be considered satisfactory and should be investigated.

We do not recommend a 2KV site pressure test on the secondary wiring with relays connected. If this has to be carried out then, as above, deliberate earth links must be removed. Note that both the positive and negative feeds to the relay's DC/DC converter are earthed via 5KV capacitors and the leakage current of these capacitors may trip the 2KV pressure test set. Also note that the capacitance effect of the secondary wiring may give rise to test set calibration errors that give impressed voltages higher than measured. To avoid this phenomenon, the pressure test set used should have the metering on the secondary (high voltage) side. Suitable test sets are manufactured by T&R Test Equipment (Type KV5 – 100). All Reyrolle relays are comprehensively pressure tested during manufacture.

5.2 Commissioning Tests

Select the required relay configuration and settings for the application.

5.2.1 Status input tests

This test checks that the status input circuits are functioning correctly. The status input circuits should be energised in turn and observed to be operating using the instruments mode 'Status Inputs' display. A '1' indicates that the status circuit is energised, a '0' indicates that it is not.
Connect the correct D.C. voltage to the following terminals to energise the status inputs :

Status Input	**+ DC Volts**	**- DC Volts**
Status 1	5	6
Status 2	27	28
Status 3	26	28
Status 4	25	28

5.2.2 Output relay tests

This test checks that the output relays are functioning correctly. The output relays should be energised in turn and the contacts should be checked for correct operation using a continuity tester. The output relays can be energised in a number of ways. The following is the recommended method :
Assign each output relay in turn to 'Relay Healthy' in the output relay menu. On pressing the ENTER key the output relay selected will be energised. Check with a continuity tester that the actual contacts have operated. De-select the output relay and check that the contact returns.

Output Relay	**Type**	**Terminal No.**
Relay 1	N/C	7 – 8
Relay 2	N/O	9 – 10
Relay 3	C/O	17 (COM) 18 (N/C) 16 (N/O)
Relay 4	N/O	11 – 12
Relay 5	N/O	19 – 20
Relay 6	N/O	21 – 22
Relay 7	N/O	23 – 24

Note : when finished testing the output relays make sure that the 'Relay healthy' is reassigned to the correct output relay given in the settings file.

5.2.3 Measurement Tests

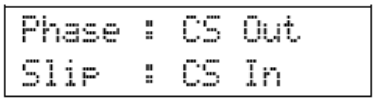
Apply A.C.volts to both of the voltage input circuits of the relay using the A.C. variable voltage sources or portable relay test set. The relay should display the correct value of voltage ± 5% which is the tolerance of the measurement display meters. The instruments mode 'Vline' and 'Vbus' meters display the secondary voltage levels.
The applied A.C. volts can be in the range of 5 – 200Vrms. Nominal volts of 63.5V or 110V are recommended.

5.2.4 Scheme Tests

It is not necessary to perform tests on all internal elements of the relay. If the settings have been checked, the external wiring checked, the status inputs and output relays verified and the relay measures satisfactorily then the relay can be considered to be working to its design requirements. It will operate correctly, to the performance

claims, and its operation under all service conditions is guaranteed. However, if added confidence is required, then the following elements can be checked. Note that the relay should be commissioned with the actual settings calculated for the particular scheme.

1. Phase Angle Tests
The CS Phase Angle detector and the SS Phase Angle detector can be tested in the following way :
Apply nominal volts to both the line and bus input terminals of the relay. On initial turn on, the relay will start in check synchronising mode. If the voltage vectors are displaced by an amount greater than the CS Phase Angle setting but not as much as the System Split
Detector angle then the relay will stay in check synchronising mode. Using the instruments display, locate the Phase and Slip instruments as shown below :



Slowly decrease the phase angle difference and check the pick up where the Phase displays ‘CS In’. Then slowly increase the phase angle and check the drop off where Phase displays ‘CS Out’. The pick up and drop off values should fall within the performance claims given in Section 2 - Performance Specification. Repeat for opposite angles.
Note : the phase angle should be adjusted slowly so that the LCD has time to update. The instrument has a 0.5 sec delay on updating. Monitoring may also be done using the output contacts.
This test should be repeated for the system synchronising settings. This is best carried out by increasing the phase angle until a split occurs and then bringing the angles in. The split will cause the relay to go into system synchronising mode. The results can be put into Table 1 at the back of this section.

2. Slip Frequency Tests
The CS Slip Frequency detector and SS Slip Frequency detector elements are more difficult to test and require variable frequency sources. A portable relay test set with fixed and variable frequency voltage source output is ideal for this. Depending on the relay scheme settings it may be difficult to test the CS and SS slip frequency elements independently without adjusting the settings. To test the CS Slip Frequency element turn the System Split Detector to OFF. This will ensure that a split is not initiated and the relay stays in check sync mode. Increase the frequency slip to a value outside of the slip frequency limits and then slowly reduce it until the element picks up. This will be indicated on the same instrument as above. Slip should display ‘CS In’. Gradually increase the slip until the element drops off as indicated by ‘CS Out’. Record the results in Table 2.

To test the SS Slip Frequency element turn the System Split Detector back to the value required for the scheme. Turn CS Slip Frequency element to OFF. Increase the phase angle until a split occurs and then repeat the above tests but checking for ‘SS In’ and ‘SS Out’. Record the results in Table 2.

All the results should fall within the performance claims given in Section 2 – Performance Specification chapter 6.
Note : remember to return all settings back to the original scheme settings if they have been changed.

3. Timer Tests
The slip timers can be tested by setting the angle between the two voltages to a value outside of the phase angle settings. Reduce the phase angle to zero and the output should not close until after the slip timer has timed out. In practice however, the timers are difficult to test without specialist test equipment and test software. There are three recommended methods :

1. Apply in phase nominal volts to the relay. The relay will issue a close only after the slip timer has timed out. Note, however, that the relay has a start-up timer of 960ms which is the minimum time before an output is given. This start-up timer effectively runs in parallel with the slip timer. If for example a CS Slip Time of 2.0sec has been selected then the time for close will be 2.0sec. If however, 0.5sec has been selected then the time for close will be 0.960sec.

2. Apply in phase volts to the relay at a level above the 5V blocking level but below the undervoltage blocking element level. The relay will time through the start-up timer. If the volts are then increased to nominal then the relay will close after the set slip time. If 0.5sec has been selected then the relay will close after 0.5sec. All results should fall within the performance claims given in chapter 2 – Performance Specification.

3. Using Reydisp Evolution software the event records will give accurate times for all of the timing events within the relay. The following events were extracted from a relay which had the CS Slip Timer set to 1.0 sec. When the phase angle moved inside the close window the actual close output was given after a time of 1.005 seconds.
00:27:41.310 , 01/01/99 Rey Raised Phase In Sync
00:27:42.315 , 01/01/99 Rey Raised Check Sync Close
The split timer can be tested in the following way. Apply nominal in phase volts to both of the voltage inputs. Cause a system split to occur by displacing the vectors by the System Split Detector setting and then turn both volts off. The system split output contact will then stay on for a time set by the System Split Timer setting. Record all results in Table 3.

4. Voltage Level Detectors
Check the pick up and drop off levels for the voltage level detector elements. Individually ramp up and down the line and bus volts and examine the 'Line/Bus Status' instrument to see where the elements actually operate. Record the results in Table 4.

5. Undervoltage Elements
Check the pick up and drop off levels for both the line undervoltage and bus undervoltage blocking elements. Examine the 'Volt Blocking' instrument to see where the elements actually operate. Record the results in Table 4.

6. Differential Voltage Elements
Check the pick up and drop off levels for the differential voltage blocking element. Examine the 'Volt Blocking' instrument to see where the elements actually operate. Record the results in Table 4. All results should fall within the performance claims given in chapter 2 – Performance Specification.

6 PUTTING INTO SERVICE

After the tests have been performed satisfactorily the relay should be put back into service as follows :

- Remove all test connections
- Where possible, the relay settings should be downloaded to a computer and a printout of the settings obtained. This should then be compared against the required settings. It is important that the correct settings group is active, if more than one group has been programmed.
- Replace all fuses and links.

APPENDIX 1 – Test Tables

Table 1 – Phase Angle Tests

		Positive angle		Negative angle	
Phase Element	Phase Setting (Degrees)	Pick Up (Degrees)	Drop Off (Degrees)	Pick Up (Degrees)	Drop Off (Degrees)
CS Phase Angle					
SS Phase Angle					

Table 2 – Slip Frequency Tests

		Positive Slip		Negative Slip	
Slip Element	Slip Setting (Hz)	Pick Up (Hz)	Drop Off (Hz)	Pick Up (Hz)	Drop Off (Hz)
CS Slip Freq.					
SS Slip Freq.					

Table 3 – Timer Tests

Timer Type	Timer Setting (sec)	Actual Time (sec)
CS Slip Timer		
SS Slip Timer		
Split Timer		

Table 4 – Voltage Element Tests

	Live Level			Dead Level		
Voltage Selector	Setting (V)	Pick Up (V)	Drop Off (V)	Setting (V)	Pick Up (V)	Drop Off (V)
Line						
Bus						

Voltage Element	Setting (V)	Pick Up (V)	Drop Off (V)
Line Undervoltage			
Bus Undervoltage			
Differential Element			