

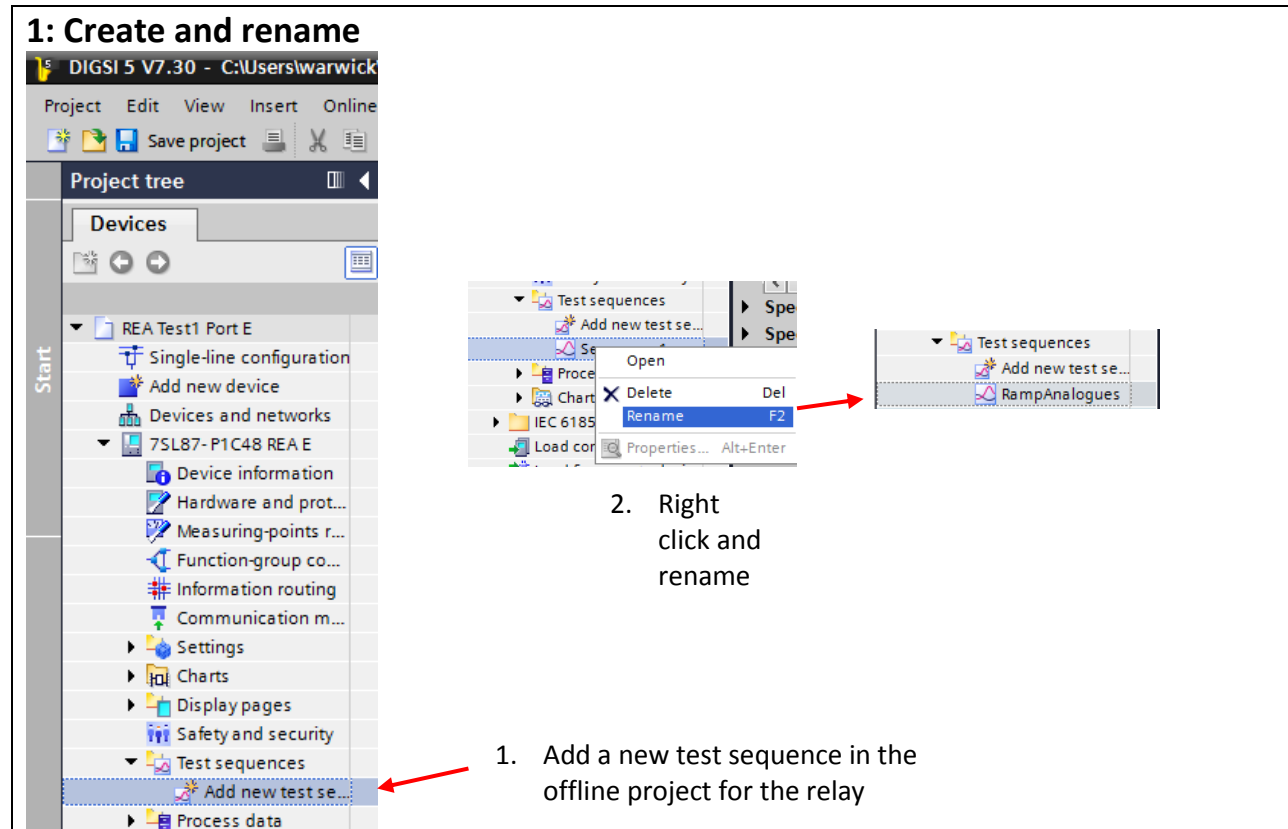
Test Sequences allow simulated values to be applied internally to the ‘input’ of the relay, allowing testing of protection functions, display and SCADA outputs with the need for external test equipment.

Test Sequences are detailed in the ‘SIPROTEC 5 Operation Manual’. Siemens “SIPROTEC 5 Application Note SIP5-APN-011 Power commissioning with SIPROTEC 5” also introduces Test Sequences and other useful commissioning/testing tools.

**QUICK GUIDE TO: Creating a Test Sequence**

In this example, we create a test sequence using two steps. The first step ramps input current from 0-1 A over 5 seconds, then the second 5 second step ramps current and voltage down by 10 %.

**1: Create and rename**

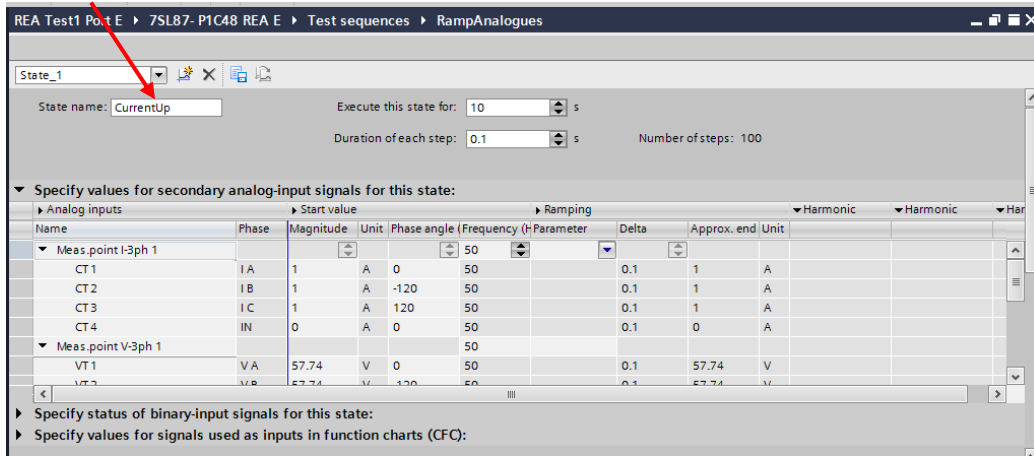


The screenshot shows the DIGSI 5 V7.30 software interface. On the left, the 'Project tree' is visible under 'Devices' > '7SL87- P1C48 REA E' > 'Test sequences'. The 'Add new test se...' option is highlighted with a red arrow. A context menu is open over the 'Test sequences' folder, with the 'Rename' option highlighted. A second red arrow points from the 'Rename' option to the 'Test sequences' folder in the project tree, where a new sequence named 'RampAnalogues' has been created.

1. Add a new test sequence in the offline project for the relay
2. Right click and rename

## 2: Setup the first step

### Rename

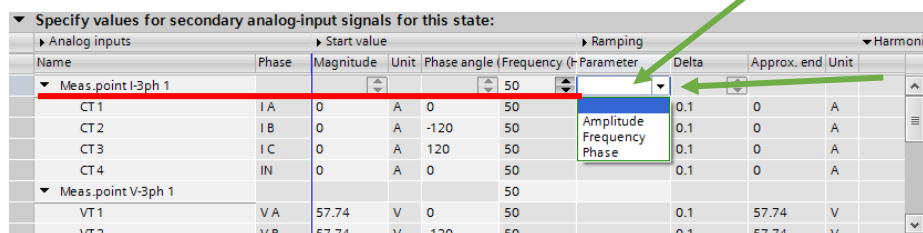


### Settings to be entered:

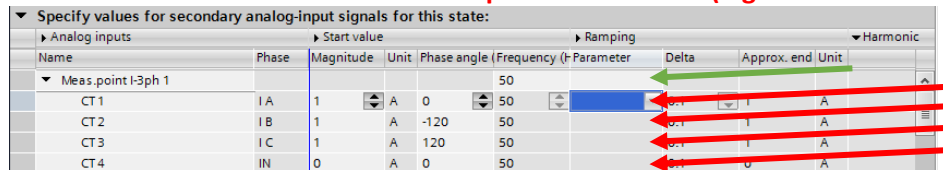
- Execute state for = 5 s
- Duration of each step 0.5 s
- Ramping Parameter (for current) = Amplitude **[Note 1]**
- Start Magnitude = 0
- Delta **[Note 2]** = 0.1 (to make 'Approx. end' value = 1)
- Voltage Start Values = 63.5 V

Test Sequence values are entered as secondary values. Keep in mind if relay is set for 1A or 5A input, and the effect CT/VT ratio settings will have on display and SCADA values.

**NOTE 1: You MUST select the parameter to be ramped via the "heading" line (e.g. 'Meas.point 1-3ph 1')**



**It cannot be selected via the individual phase lines below (e.g. CT1 CT2 CT3 etc).**



**NOTE 2: Setting value "Delta"**

The setting value 'Delta' is a multiplier of the 'number of steps'  
 The resulting change = Start Magnitude + (delta setting \* number of steps)  
 The delta value can be a minimum value of -0.01/0.01  
 You may need to alter the number of steps to be able to obtain the desired resolution of the delta setting.

**Worked example:**

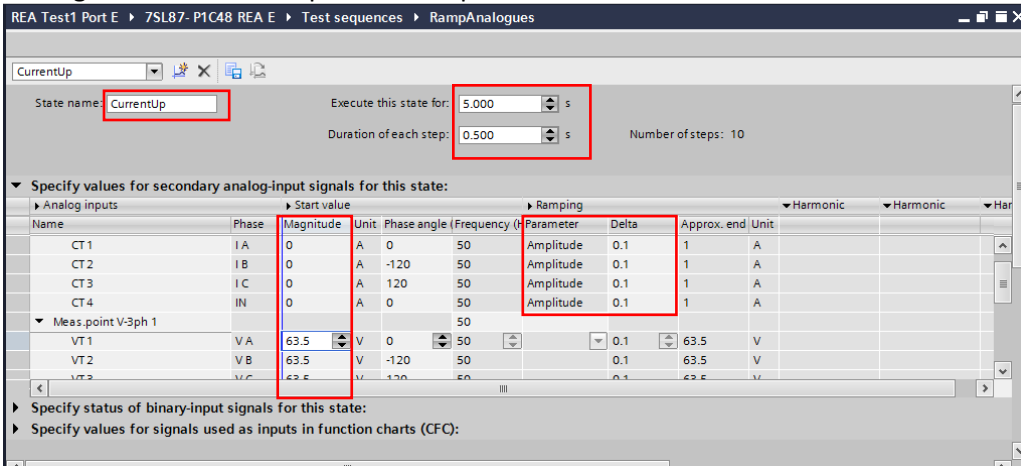
Number of steps (in this step of the sequence) = 50  
 Therefore if using Delta = 1, '50' would be added to the magnitude  
 In below example:  
 Phase A, current start magnitude = 1, Delta = 1, therefore end value = 1+ (1 x 50) [i.e. 51]  
 Phase B, current start magnitude = 10, Delta = 1, therefore end value = 10 + (1 x 50) [i.e. 60]  
 Phase C, current start magnitude = 1, Delta = -0.01, therefore end value = 1+ (-0.01 x 50) [i.e. 0.5]

Analog inputs		Start value			Ramping			Harmonic	
Name	Phase	Magnitude	Unit	Phase angle (Frequency (Hz))	Parameter	Delta	Approx. end	Unit	
▼ Meas.point I-3ph 1									
CT1	IA	1	A	0 50	Amplitude	1	51	A	
CT2	IB	10	A	-120 50	Amplitude	1	60	A	
CT3	IC	1	A	120 50	Amplitude	-0.01	0.5	A	
CT4	IN	1	A	0 50	Amplitude	-0.02	2.2351...	A	
▼ Meas.point V-3ph 1									
VT1	VA	57.74	V	0 50		0.1	57.74	V	
VT2	VB	57.74	V	-120 50		0.1	57.74	V	
VT3	VC	57.74	V	120 50		0.1	57.74	V	

**Warning:**  
 Values may be given in engineering units. Enlarge the column to see the full detail.

Approx. end value
51
60
0.5
2.235174E-08

**Settings made for first sequence example:**



REACT Test1 Port E > 7SL87- P1C48 REA E > Test sequences > RampAnalogues

CurrentUp

State name: CurrentUp

Execute this state for: 5.000 s

Duration of each step: 0.500 s

Number of steps: 10

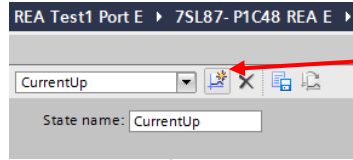
Specify values for secondary analog-input signals for this state:

Analog inputs		Start value			Ramping			Harmonic	
Name	Phase	Magnitude	Unit	Phase angle (Frequency (Hz))	Parameter	Delta	Approx. end	Unit	
CT1	IA	0	A	0 50	Amplitude	0.1	1	A	
CT2	IB	0	A	-120 50	Amplitude	0.1	1	A	
CT3	IC	0	A	120 50	Amplitude	0.1	1	A	
CT4	IN	0	A	0 50	Amplitude	0.1	1	A	
▼ Meas.point V-3ph 1									
VT1	VA	63.5	V	0 50		0.1	63.5	V	
VT2	VB	63.5	V	-120 50		0.1	63.5	V	
VT3	VC	63.5	V	120 50		0.1	63.5	V	

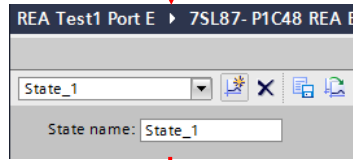
Specify status of binary-input signals for this state:

Specify values for signals used as inputs in function charts (CFC):

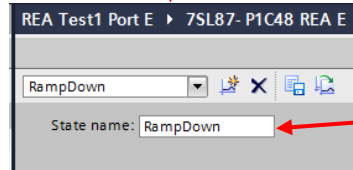
### 3: Add second step



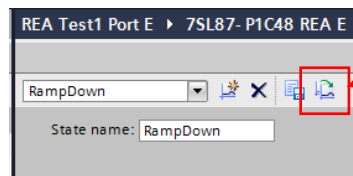
1. Add new test sequence state



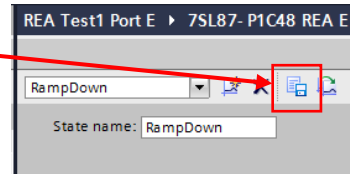
2. Rename



3. "Take end values from last step as start values for this step".  
Use this button to pre-set the start condition to the same values as the end of the preceding step



The save button is only for saving the test sequence as a text file for use in other applications. The test sequence is saved as part of the DIGSI 5 project file.



### 4: Settings for second stage.

Specify values for secondary analog-input signals for this state:

Analog inputs		Start value			Ramping			Harmonic	
Name	Phase	Magnitude	Unit	Phase angle	Frequency (Hz)	Parameter	Delta	Approx. en	Unit
▼ Meas.point I-3ph 1									
CT 1	IA	1	A	0	50	Amplitude	-0.01	0.9	A
CT 2	IB	1	A	-120	50	Amplitude	-0.01	0.9	A
CT 3	IC	1	A	120	50	Amplitude	-0.01	0.9	A
CT 4	IN	0	A	0	50	Amplitude	0	0	A
▼ Meas.point V-3ph 1									
VT 1	VA	63.5	V	0	50	Amplitude	-0.64	57.1	V
VT 2	VB	63.5	V	120	50	Amplitude	-0.64	57.1	V

Settings to be entered:

Execute state for = 5 s

Duration of each step 0.5 s

Ramping Parameter (for current) = Amplitude

Delta = -0.01 (to make 'Approx. end' value = 0.9)  
 Ramping Parameter (for voltage) = Amplitude  
 Delta = -0.64 (to make 'Approx. end' value = 57.1)

*As the minimum possible Delta value is 0.01, the number of steps was chosen as 10, to allow a current magnitude change of 0.1 A (i.e. 10 %). For voltage, this results in Delta=1, being a 10 V change, hence the Delta needs to be -0.64 to obtain a 6.4 volt decrease for the voltage value (i.e. to obtain a 10 % reduction from the start voltage)*

### 5: Save

Save the setting file.

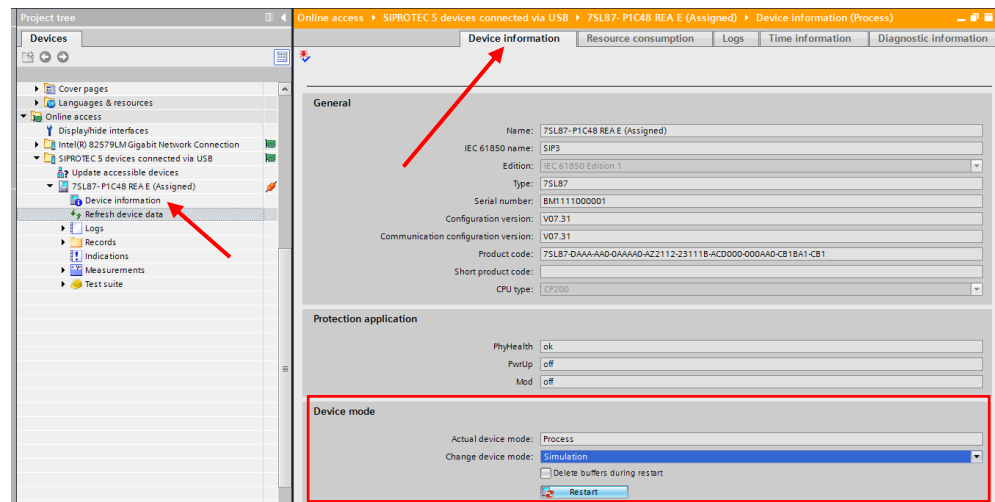
## QUICK GUIDE TO: Running a Test Sequence

### 1: Device Mode = Simulation

The relay must be in Simulation Mode to allow Test Sequences to operate.

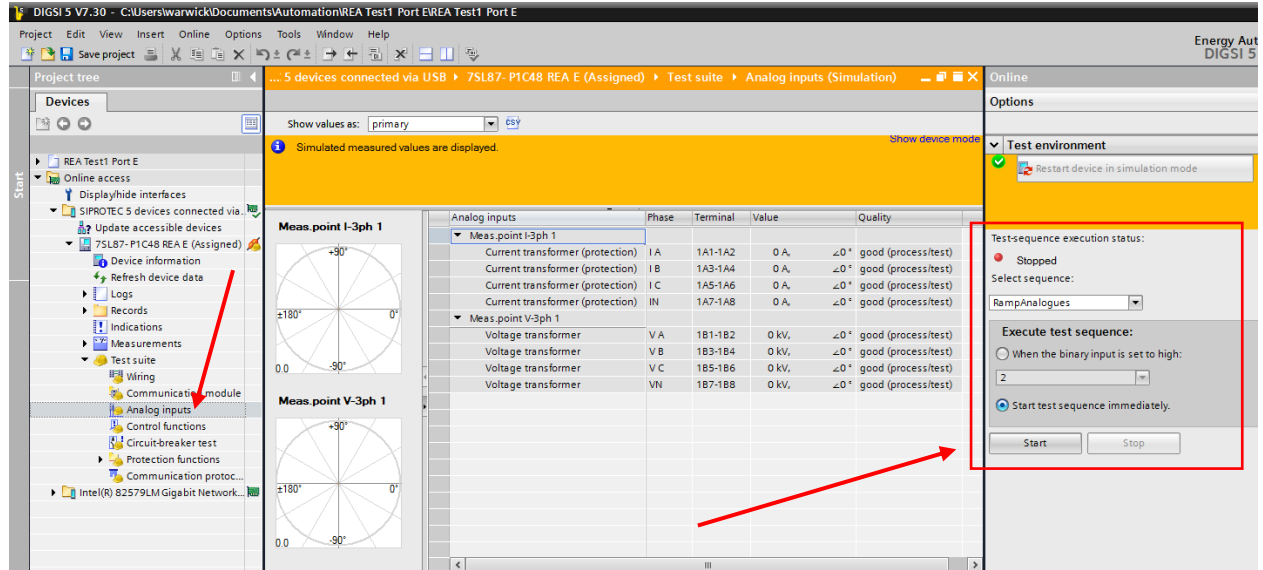
<b>Commissioning Mode</b>	All protection functions are inactive to allow wiring and other tests to be performed. Allows binary input/outputs to be checked, SCADA points to be operated etc.
<b>Process Mode</b>	Normal operation.
<b>Simulation Mode</b>	Similar to Process mode, but allows test sequences to be run, replacing actual measured inputs with simulated values.

Some DIGSI 5 test functions will provide a short-cut button to change modes. It is always possible to check and change the mode from the online instance by viewing the online 'Device Information'. Here the device mode can be changed (which may require a device restart).



## 2: Use the “Test suite”

When in Simulation Mode, the “Analog Inputs” Test suite, allows the Test Sequence to be selected and run.



5 devices connected via USB ▶ 7SL87- P1C48 REA E (Assigned) ▶ Test suite ▶ Analog inputs (Simulation) ▶ Online

Show values as: primary

Simulated measured values are displayed.

Analog inputs	Phase	Terminal	Value	Quality
<b>Meas.point I-3ph 1</b>				
Current transformer (protection)	I A	1A1-1A2	0 A	∠0° good (process/test)
Current transformer (protection)	I B	1A3-1A4	0 A	∠0° good (process/test)
Current transformer (protection)	I C	1A5-1A6	0 A	∠0° good (process/test)
Current transformer (protection)	I N	1A7-1A8	0 A	∠0° good (process/test)
<b>Meas.point V-3ph 1</b>				
Voltage transformer	V A	1B1-1B2	0 kV	∠0° good (process/test)
Voltage transformer	V B	1B3-1B4	0 kV	∠0° good (process/test)
Voltage transformer	V C	1B5-1B6	0 kV	∠0° good (process/test)
Voltage transformer	V N	1B7-1B8	0 kV	∠0° good (process/test)

Test environment

Restart device in simulation mode

Test-sequence execution status:  
 Stopped

Select sequence:  
 RampAnalogues

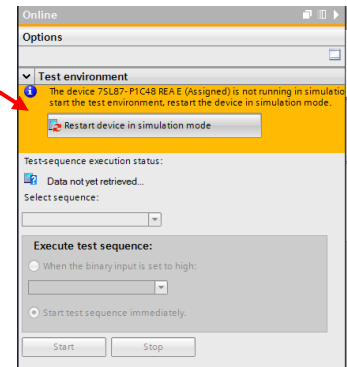
Execute test sequence:  
 When the binary input is set to high:  
 2

Start test sequence immediately.

Start Stop

If the relay is not in Commissioning mode notification will be given.

Test Sequences can also be run via the Protection function testing routines, the Communication protocol test suite, and effects of the Test Sequence simulation can be seen in many other screens.



Online

Options

Test environment

The device 7SL87-P1C48 REA E (Assigned) is not running in simulation mode. start the test environment, restart the device in simulation mode.

Restart device in simulation mode

Test-sequence execution status:  
 Data not yet retrieved...

Select sequence:

Execute test sequence:  
 When the binary input is set to high:

Start test sequence immediately.

Start Stop

## QUICK GUIDE TO: Saving and Errors

### 1: Saving

Test Sequences are stored in the offline project (only), and are not sent to the relay as part of the “setting file”.

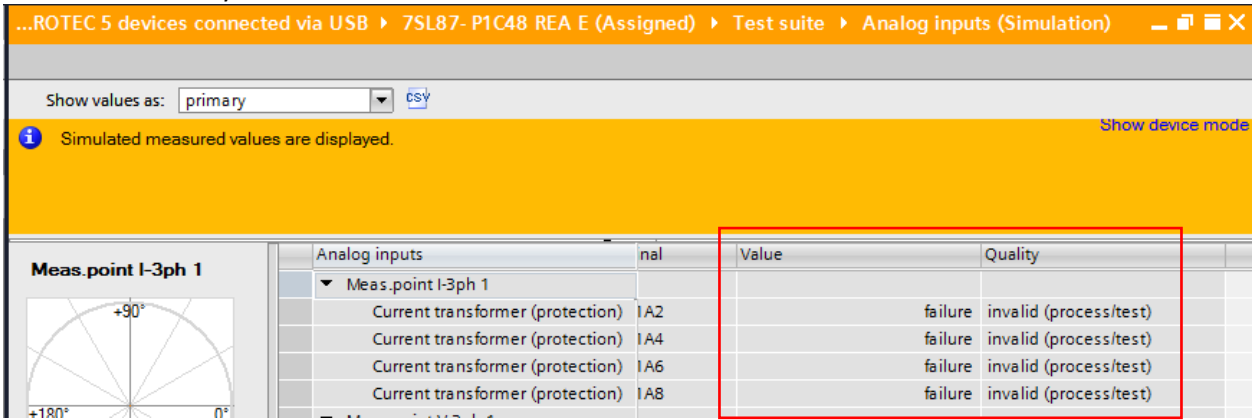
Iterative changes can be made to the offline Test Sequence’s and ‘played’ via the Online instance ‘Test suite’ without the need to save project or upload new settings.

DIGSI 5’s ‘Device Comparison’ functions do not react to any changes/differences in the (offline) Test Sequences.

## 2: Value = failure

If a simulation value is reported as 'Failure' during a test, consider the validity of the input values.

For example with the current inputs the SIPROTEC 5 relay preforms an "Analog-Channel Supervision via Fast Current-Sum" check, where the unbalance currents from the three phases are summed and checked against the expected neutral current (Refer to manual specific to the relay being used). If the simulated values used do not have the correct neutral unbalance, the relay may flag the quality of values as 'invalid' and the values may not be utilised.



The screenshot shows the software interface for a SIPROTEC 5 relay. The breadcrumb path is: ...ROTEC 5 devices connected via USB > 7SL87- P1C48 REA E (Assigned) > Test suite > Analog inputs (Simulation). The 'Show values as' dropdown is set to 'primary'. A message states: 'Simulated measured values are displayed.' Below this is a table of analog inputs for 'Meas.point I-3ph 1':

Meas.point I-3ph 1	Value	Quality
Current transformer (protection) IA2	failure	invalid (process/test)
Current transformer (protection) IA4	failure	invalid (process/test)
Current transformer (protection) IA6	failure	invalid (process/test)
Current transformer (protection) IA8	failure	invalid (process/test)

Example valid single phase setting:

Analog inputs		Start value		Ramping					
Name	Phase	Magnitude	Unit	Phase angle (Frequency (Parameter	Delta	Approx. end	Unit		
Meas.point I-3ph 1				50					
CT 1	IA	1	A	0	50	0.1	1	A	
CT 2	IB	0	A	-120	50	0.1	0	A	
CT 3	IC	0	A	120	50	0.1	0	A	
CT 4	IN	1	A	180	50	0.1	1	A	

*In a single phase injection of current, current in Phase IA, is expected to be of the same magnitude and 180 deg opposite to the IN Phase – otherwise the supervision functions of the relay may flag data as 'failed/invalid' and expected outputs may be prevented by error checking routines.*