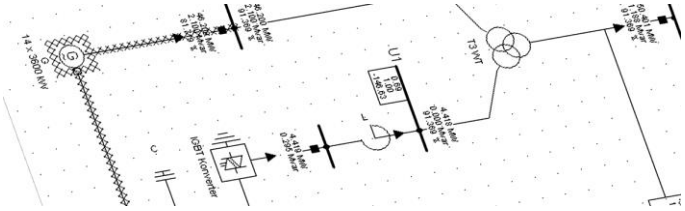

DIgSILENT Technical Documentation

ABB SPAJ 32x
PowerFactory
V001 Relay model description

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1 Model general description

The ABB SPAJ 32x PowerFactory relay model is intended to mock up the ABB SPAJ 321 and the ABB SPAJ 320 relay.

The ABB SPAJ 321 and the ABB SPAJ 320 relay are three phase and neutral current overcurrent relays with a harmonic measurement module for blocking the earth fault protection module and an additional threshold doubling feature.

The ABB REJ 32x PowerFactory relay model is implementing all the protective functions available in the following relay modules:

- SPCJ 3C3
- SPCJ 1C7
- SPCJ 1C20

The model consists of a main relay containing the CT, the measurement blocks and the output logic and three subrelay one of each relay module.

1.1 Main relay

1.1.1 Measurement and acquisition

1.1.1.1 Available Units

The primary currents are measured by two current transformers ("Ct-3p" and "Ct-3I0" blocks)

Two measurement units ("Measure Ph" and "Measure 3I0" blocks) are fed by these CTs.

1.1.1.2 Functionality

The input signals are sampled in the relay model at 20 samples/cycle; the RMS value is calculated integrating the sampled values. Please notice that no info is available in the manual about the sampling rate or the algorithm used to extract the 2nd harmonic. For this reason an implementation common in many protective relays has been used (DFT calculation).

1.1.1.3 Data Input

Please note that the nominal current (relay "In" setting) value MUST be entered in all measurement units.

1.1.2 Output logic

1.1.2.1 Available Units

The output logic is implemented by the "Output logic" block.

1.1.2.2 Functionality

This block is operating the breaker. Please disable the "Output logic" block to disable the relay model ability to open the power circuit.

The signal operating the breaker is "A". The "B", C" , "D", "E" ,F" output signals are available as well and their logic can be configured in the "Logic" tab page of the "Output logic" block.

1.1.3 3C3 subrelay

1.1.3.1 Available Units

- One 3 phase inverse time overcurrent element ("I>" block)
- One 3 phase definite time overcurrent element ("I>>" block)
- One "starting situation" detector ("0.12In", "3In", "2In", "ICalc", "Tripconst" and "Inrushdetector" block) with threshold doubling feature

1.1.3.2 Functionality

This subrelay implements the phase overcurrent protective elements including the starting detection logic.

The PF model contains all the protective elements available in the relay.

The inverse time overcurrent elements support the following trip characteristics:

- Definite time

- IEC ”Extremely inverse”
- IEC “Very inverse”
- IEC “Normal inverse”
- IEC ”Long time inverse”

1.1.3.3 Data Input

To disable the threshold doubling feature please write “multiplier=0” in the “Logic” tab page of the “ICalc” dialog.

The phase element trip threshold and time delay can be set in the “I>” and in the “I>>” block.

Please notice that in the model the range of the definite time characteristic time delay is covering all the ranges available in the relay for different position of the “SG1/1” and “SG1/2” switches. The “I>>” element time trip threshold range is covering both ranges available in the relay for different positions of the “SG1/6” switch, the time delay range is covering all ranges available in the relay for different positions of the “SG1/7” and “SG1/8” switch.

1.1.4 IC20 subrelay

1.1.4.1 Available Units

The current 2nd harmonic is calculated by the “Measure 2nd harmonic” block and the blocking threshold is implemented by the “SPCJ 1C20 I2f” block. The “2.5In” block represents the level of zero sequence current which is disabling the 2nd harmonic blocking feature, the “SPCJ 1C20 I1f” block the minimum zero sequence current activating the harmonic blocking.

1.1.4.2 Functionality

This subrelay implements the 2nd harmonic detection logic and relevant ground overcurrent element blocking logic.

Please notice as no info is available in the manual regarding the 2nd harmonic measurement method so a DFT method is used in the model.

The feature implementation is including also a minimum zero sequence current activation threshold and a maximum zero sequence current disabling the feature.

1.1.4.3 Data Input

The 2nd harmonic activation threshold must be inserted in the "SPCJ 1C20 I2f" block, the minimum zero sequence current activating the feature must be inserted in the "SPCJ 1C20 I1f" block.

1.1.5 IC7 subrelay

1.1.5.1 Available Units

- One ground current time definite overcurrent element ("I0>" block)
- One high set ground current definite time overcurrent element ("I0>>" block)

1.1.5.2 Functionality

This subrelay implements the ground overcurrent protective elements

The PF model contains all the protective elements available in the relay.

1.1.5.3 Data Input

The ground element trip threshold and time delay can be set in the "I0>" and in the "I0>>" block.

Please notice that in the model the range of the "I0>" trip threshold is covering all the ranges available in the relay for different position of the "SG1/2" and "SG1/3" switches, the time delay range is covering both ranges available in the relay depending up on the "SG1/1" switch position . The "I0>>" element time delay range is covering both ranges available in the relay for different positions of the "SG1/8" switch, the trip threshold range is covering all ranges available in the relay for different positions of the "SG1/6" and "SG1/7" switch.

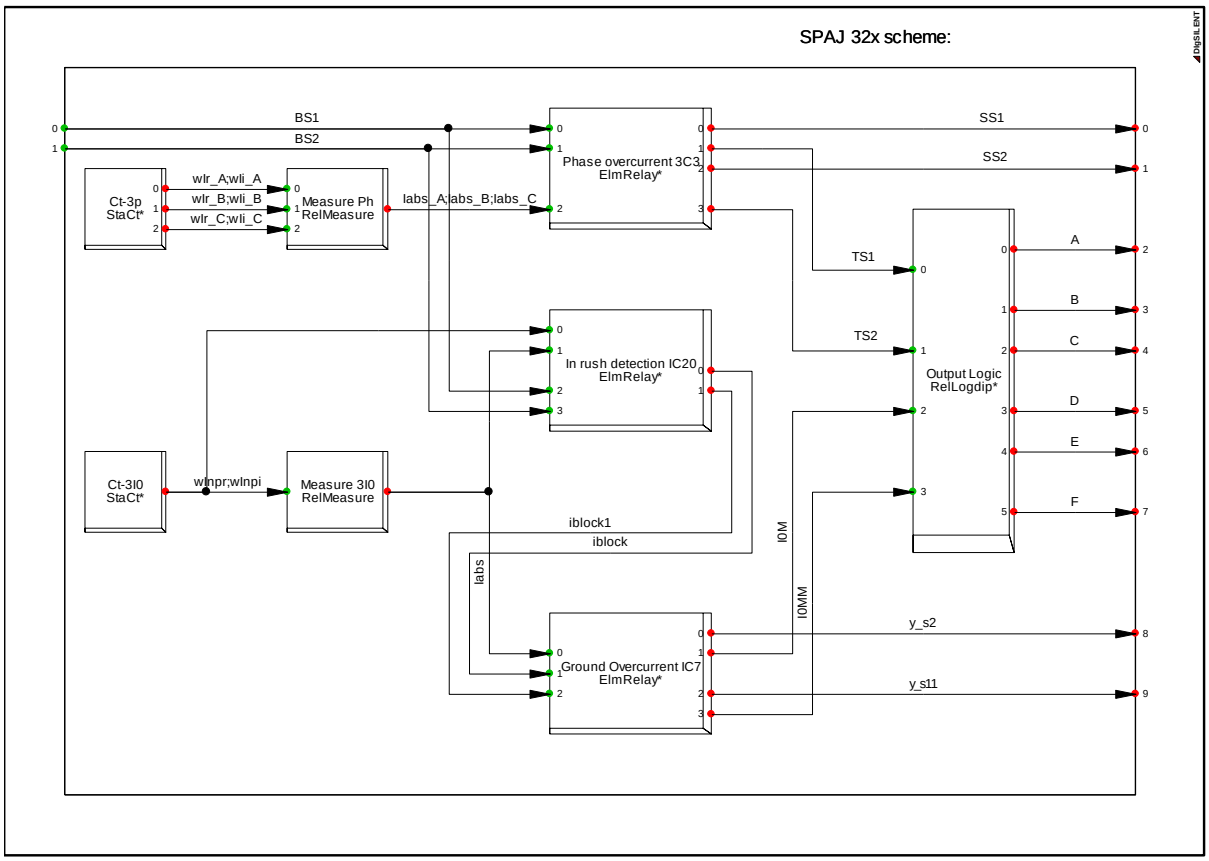
2 Relay not supported features

The following features are not supported:

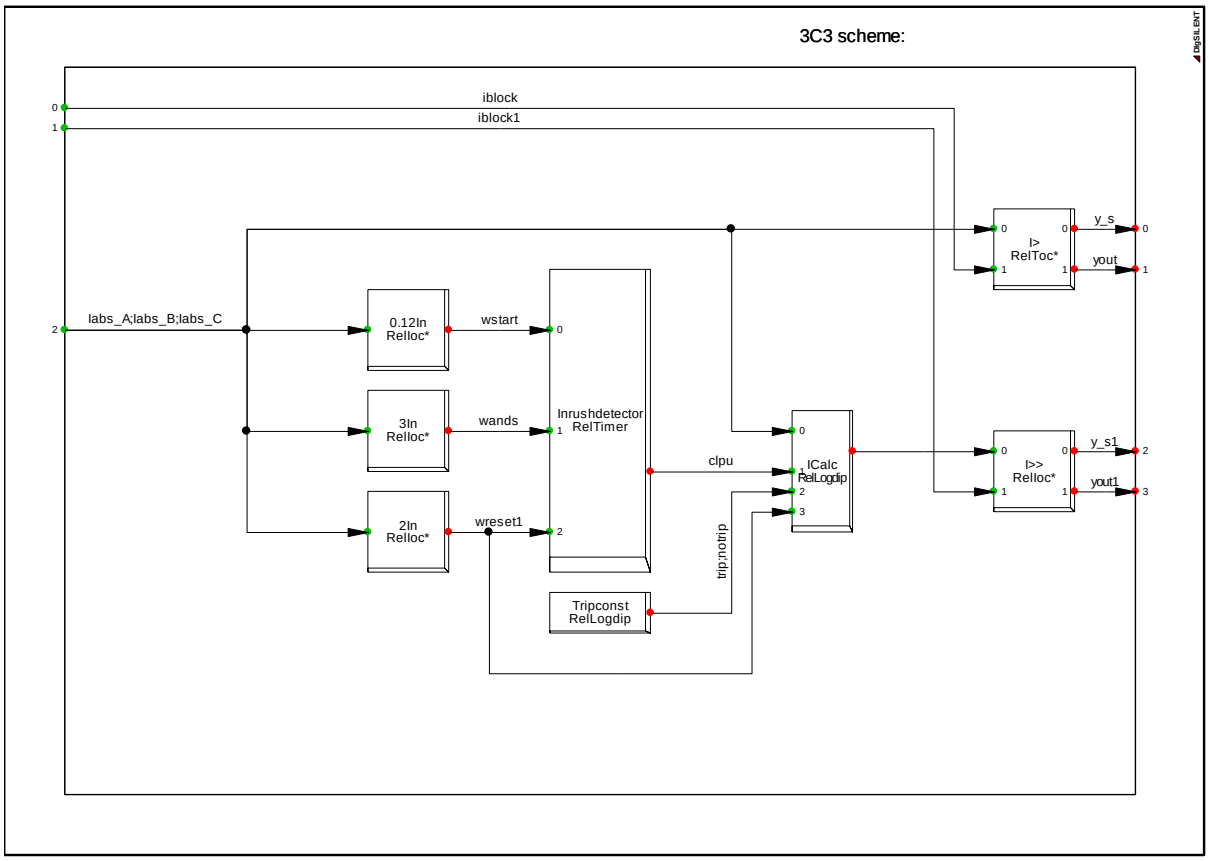
- Selection of the latching function for the tripping signals ("SG1/4" switch)

3 Model scheme

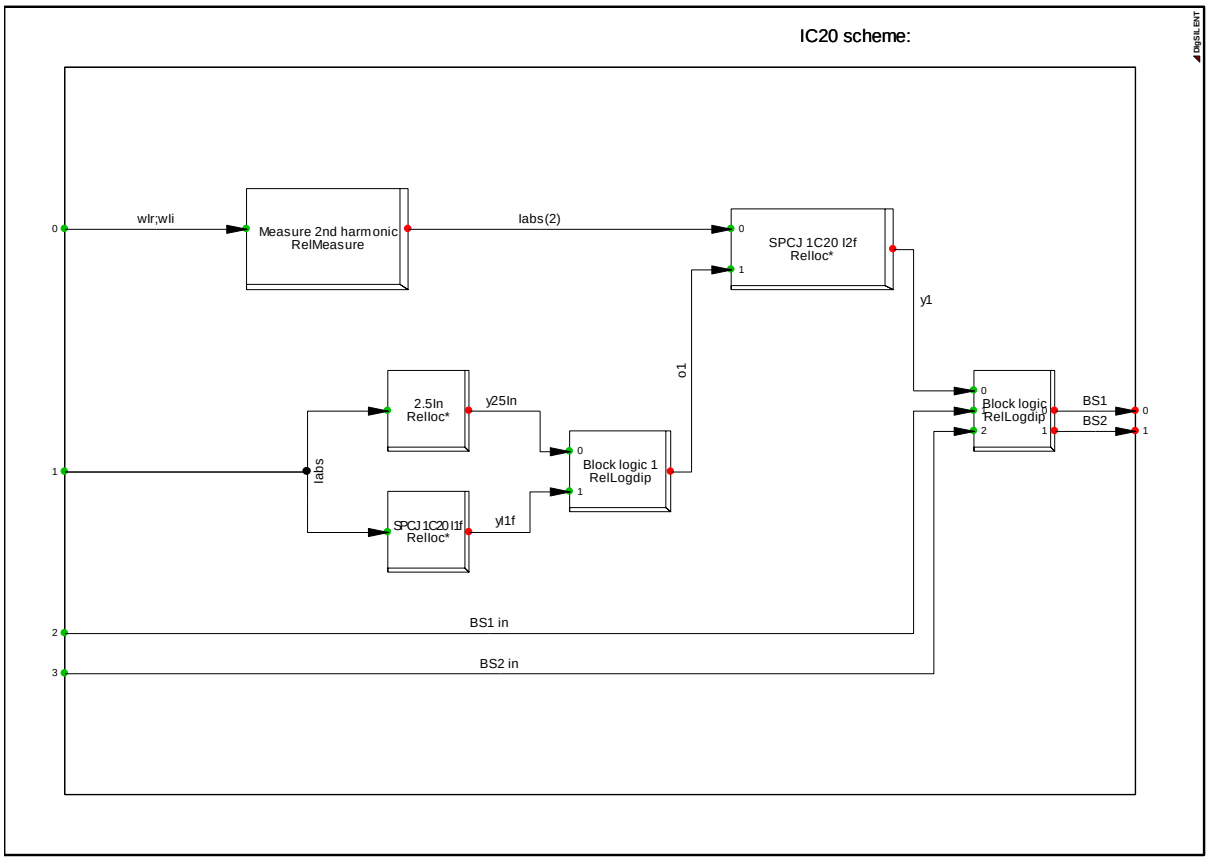
3.1 Main relay



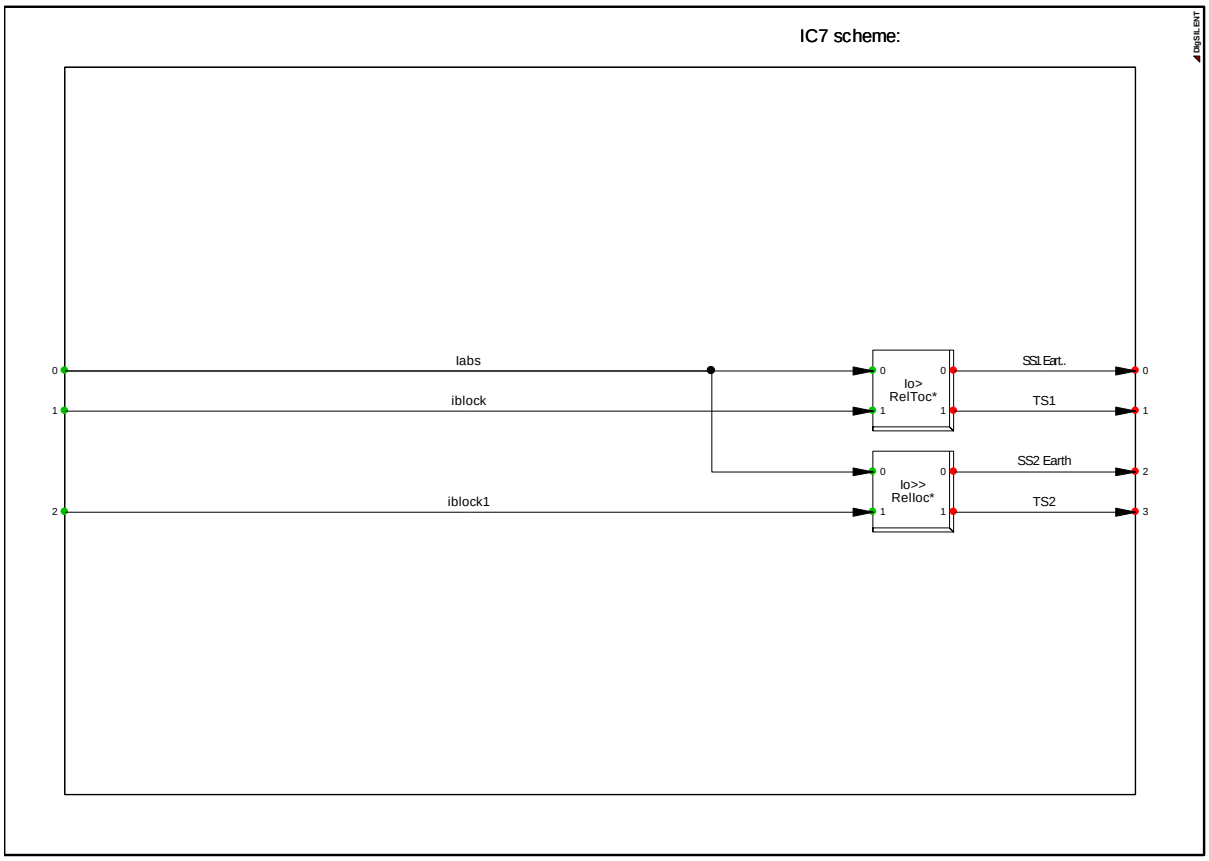
3.2 3C3


3C3 scheme:
iblock
iblock1
labs_A;labs_B;labs_C
0.12In
Relloc*
3In
Relloc*
2In
Relloc*
wstart
wands
wreset1
Inrushdetector
RelTimer
Tripconst
RelLogdip
clpu
trip;notrip
ICalc
RelLogdip
I>
RelToc*
y_s
yout
I>>
Relloc*
y_s1
yout1

3.3 IC20


IC20 scheme:
wIr;wIi
Measure 2nd harmonic
RelMeasure
Iabs(2)
SPCJ 1C20 I2f
Relloc*
y1
o1
2.5In
Relloc*
y25In
Block logic 1
RelLogdip
Iabs
SPCJ 1C20 I1f
Relloc*
yI1f
Block logic
RelLogdip
BS1
BS2
BS1 in
BS2 in

3.4 IC7


IC7 scheme:
labs
iblock
iblock1
Io>
RelToc*
Io>>
Relloc*
SS1 Eart..
TS1
SS2 Earth
TS2
0
1
2
0
1
2
3

4 References

The model implementation has been based on the information available in the following documents:

- "SPAJ 320 C Combined overcurrent and earth-fault relay 1MRS 750424-MBG Issued: April 1999 Version: B/09.11.2001"
- "General characteristics of C-type relay modules User´s manual and Technical description 1MRS 750328-MUM EN Issued 96-02-19 Version A (replaces 34 SPC 2 EN1)"
- "SPCJ 3C3 Overcurrent relay module User´s manual and Technical description 1MRS 750602-MUM EN Issued 96-12-30 Modified 97-12-31 Version B (replaces 34 SPCJ 2 EN1)"
- "SPCJ 1C8 Non-directional earth-fault relay module User´s manual and Technical description 1MRS 750603-MUM EN Issued 96-12-31 Version A (replaces 34 SPCJ 3 EN1)"
- "SPCJ 1C20 Harmonics measuring overcurrent relay module User´s manual and Technical description 1MRS 750604-MUM EN Issued 96-12-31 Version A (replaces 34 SPCJ 5 EN1)"