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SIPROTEC 5 Application Note

SIP5-APN-021:
SIPROTEC 5 Line Protection with two FG Line

Answers for infrastructure and cities.

SIPROTEC 5 - Application: SIPROTEC 5 Line Protection with two FG Line

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1 SIPROTEC 5 Line Protection with two FG Line

1.1 Summary

The flexibility of the SIPROTEC 5 Protection allows for the combination of diverse protection functions in one device. This allows for customized solutions with optimal match to the specific application. A further advancement in this area is the ability to apply the Function Group Line twice in the line protection devices. This application note will illustrate this, providing examples and guidelines for the efficient application. The focus is on the application of 2 FG Line, other not directly associated details are not covered. Furthermore the processor load is checked and attention is given to minimizing the application of functions that require a lot of CPU resources.

1.2 Example

In the breaker-and-a-half scheme shown below the SIPROTEC 7SA87 must be applied with a connection to all 3 CT measuring points and the two voltage transformers on the lines. Distance protection for both lines must be applied in the same device.

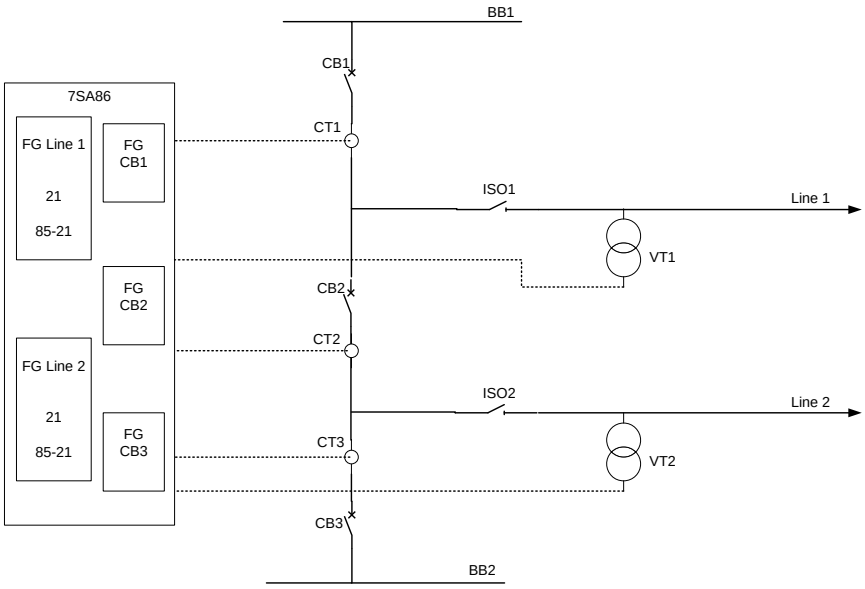


Figure 1: Schematic for Example 1

1.2.1 Hardware

It must be checked how many measuring inputs and binary I/O is required in order to select the suitable device I/O.

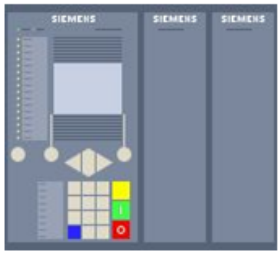
Item	Description	Number required
CT	Current measuring points, 3 phase plus residual current	3
VT	Voltage measuring points, 3 phase to ground	2
BI	Binary inputs	24
BO	Binary outputs	18

Table 1: Scope of Hardware

The following device is selected using the Configuration Tool:

Device: 7SA86 Distance Prot. 3-pole

Product code
Short: P1A19257
Long: 7SA86-DAAA-AA0-0AAAA0-AZ0111-12111A-AAA000-000AA0-CH1BA1-CB1CA1



Housing width:	4/6 x 19"
Housing type:	Flush mounting
Binary inputs:	23
Binary outputs:	26 Relays (6 Standard, 20 Fast, 0 High-Speed, 0 Power)
Current transformers:	12 for protection, 0 for measurement and sensitive ground-current detection
Voltage transformers:	8
Modules in 19" row 1:	IO208 , PS201 , IO202 , IO201
Modules in 19" row 2:	
Number of LEDs:	16

Figure 2: Result of Configuration

The above screen shot shows the result of an example configuration that meets the hardware requirement.

1.2.2 Apply Measuring Points and Function Groups in DIGSI

In a new Project the above configuration result is used to add the new device (Use the Template "Line Device Empty):

The following steps are then done:

- Add 3 CT Measuring Point (3phase) and assign terminals
- Add 2 VT Measuring Point (3phase – ground) and assign terminals
- Add 2 FG Line from Library
- Add 3 FG Circuit Breaker from Library

1.2.3 Function-group connections

Once the above has been inserted the interaction between the 2 FG Line and the 3 FG Circuit Breaker was well as the Measuring Point assignment must be done. The result is shown in the screenshot below:

Connect measuring points to function group

	Line 1		Line 2		Circuit breaker 1				Circuit breaker 2				Circuit breaker 3			
Measuring point	V 3ph	I line 3ph	V 3ph	I line 3ph	V	I 3ph	V sync1	V sync2	V	I 3ph	V sync1	V sync2	V	I 3ph	V sync1	V sync2
(All)	(All)	(All)	(...	(All)	(...	(...	(All)	(All)	(...	(...	(...	(...	(...	(...	(A...	(A...
Meas.point I-3ph 1[ID 1]		X				X										
Meas.point I-3ph 2[ID 2]		X		I						X						
Meas.point I-3ph 3[ID 3]				X										X		
Meas.point V-3ph 1[ID 4]	X															
Meas.point V-3ph 2[ID 5]			X													

Figure 3: Measuring Point assignment

The interaction between Line and Circuit breaker must be set. This ensures that the relevant circuit breaker status, such has switching state, is informed to the associated FG Line:

Connect function group to circuit-breaker groups			
Protection group	Circuit breaker 1	Circuit breaker 2	Circuit breaker 3
(All)	(All)	(All)	(All)
Line 1	X	X	
Line 2		X	X

Figure 4: Association CB with Line

The framework for the application is now in place. The next step will be to add the protection functions.

1.3 Resource consumption

The application of a 2nd FG Line in the same device results in a severe increase of the system load. When such a 2nd FG Line is applied, it is advisable to check the resource consumption with DIGSI whenever a new protection function is added or removed.

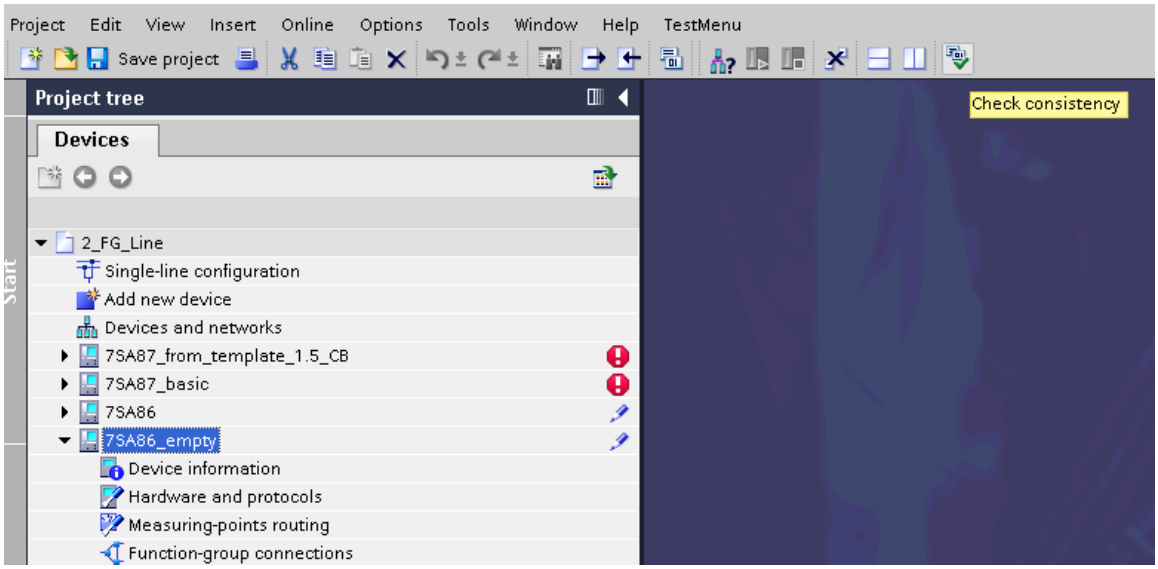


Figure 5: System Consistency Check

Before checking the resource consumption, select the device with mouse click so that it is highlighted (7SA86_empty) in the above screen shot. Then click on the icon “Check consistency” in the tool bar. If a red exclamation mark is displayed, the inconsistency must be removed.

To check the Processor Load, the “Resource consumption” tag under Device information must be opened:

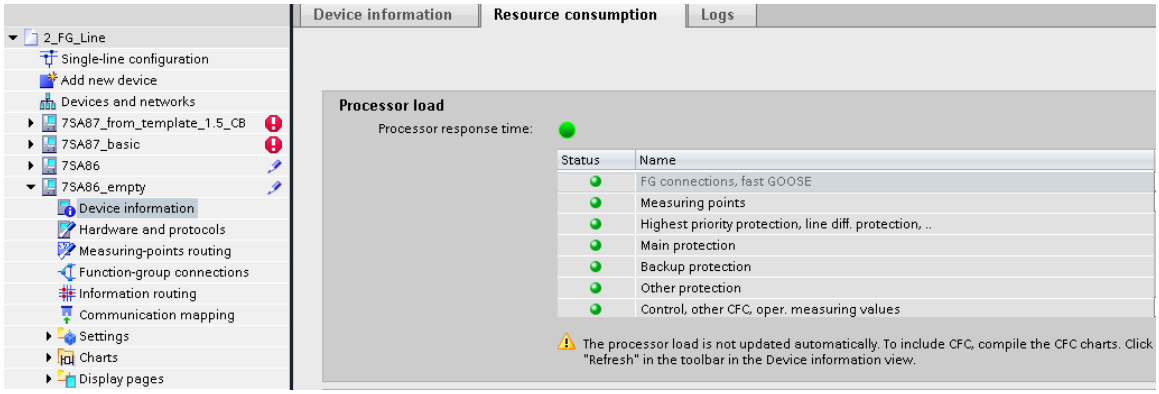


Figure 6: Resource consumption

As long as all the status points and the overall "processor response time buttons remain green the configuration is within the available CPU capability.

1.4 Add protection functions

Now the required protection functions are applied. If subsequently the Processor load (see Figure 6) is no longer green the applied scope of functions exceeds the capacity of the device.

- Add Distance Protection to each FG Line.
- Add 85-21 to each FG Line

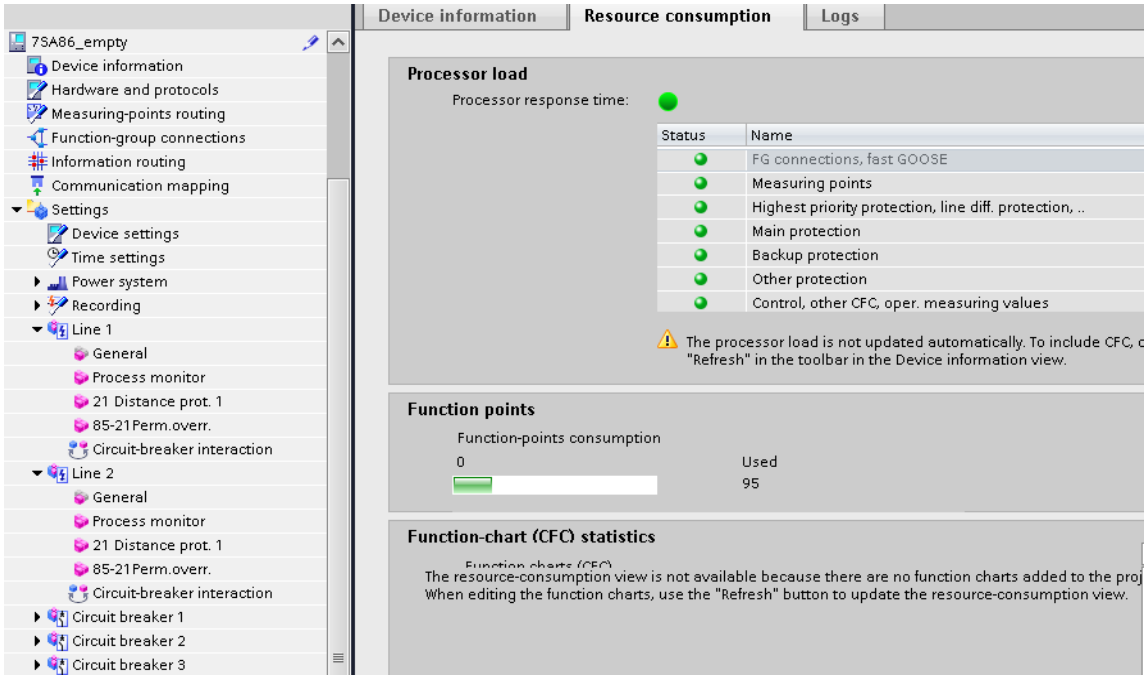


Figure 7: Recheck Resource consumption after addition of functions

The resource consumption is still green. The next functions are applied:

- Add measured voltage failure detection to each FG Line.
- Add AR function in all 3 FG Circuit Breaker.

A re-check of the resource consumption is still green.

1.5 Processor Load Limit in this example (V03.00)

Once the above configuration is applied there is no more capacity for high priority functions e.g. High Speed O/C. The table below lists the processor load critical content of the application:

Item	Description	Amount
Meas.point I-3ph	3-phase current measurement including residual current.	3 sets = 12 currents
Meas.point V-3ph	3-phase voltage measurement.	2 sets = 8 voltages
FG Line	Function Group Line provides the frame for line protection	2 instances
FG Circuit breaker	Function Group Circuit breaker includes all breaker related functions.	3 instances
21 Distance protection	The distance protection is a high priority function with very short response time.	2 instances

Table 1: Critical Functions for Processor Load

1.6 Conclusion (V03.00)

In this application the combination of 2 FG Line with a 21 Distance protection in each FG Line results in full exploitation of the available processor capacity. Less time critical functions such as auto re-closure can still be applied but high priority protection functions such as e.g. high speed O/C would result in exceeding the Processor Load. DIGSI will then not allow the configuration to be loaded to the device. Functions must then be removed until DIGSI indicated that Processor Load is in the green area (Figure 7).

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