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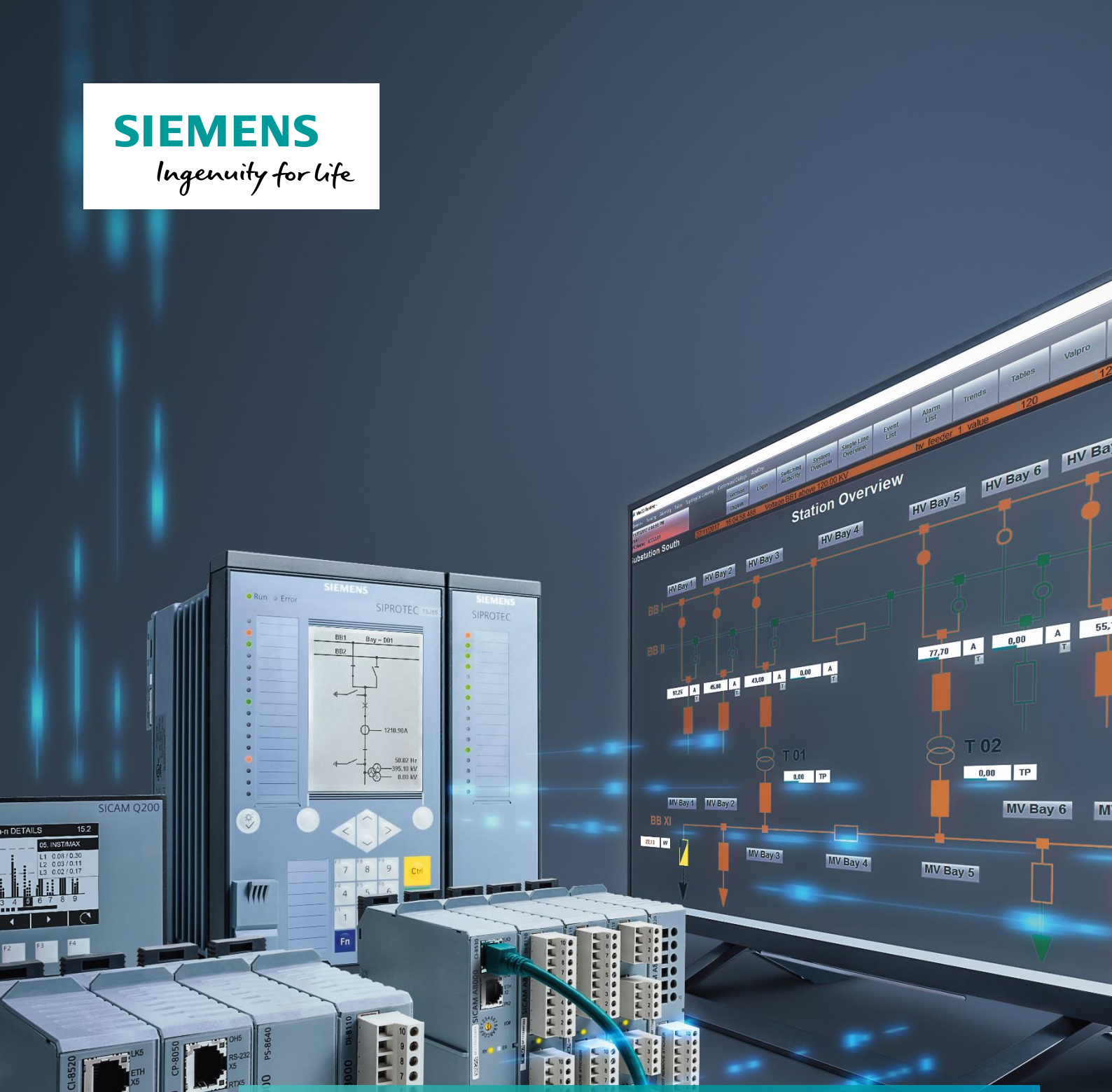

2nd Harmonic Blocking of 3I0 Protection

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SIPROTEC 5 Application

2nd Harmonic Blocking of 3I0 Protection

APN-059, Edition 1

Content

1 2nd Harmonic Blocking of 3I0 Protection

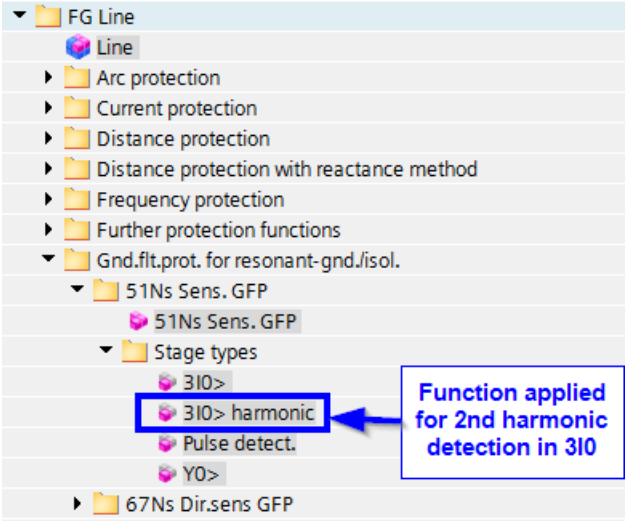
1.1 Introduction

The residual current (3I0) protection stages can require very sensitive settings, in some cases smaller than 5% nominal current. For such stages there is significant risk of maloperation due to transients introduced on the primary side, e.g. in-rush current on power transformers; or on the secondary side due to saturation of phase CTs when the residual current is calculated or measured in the star-point of the phase CTs.

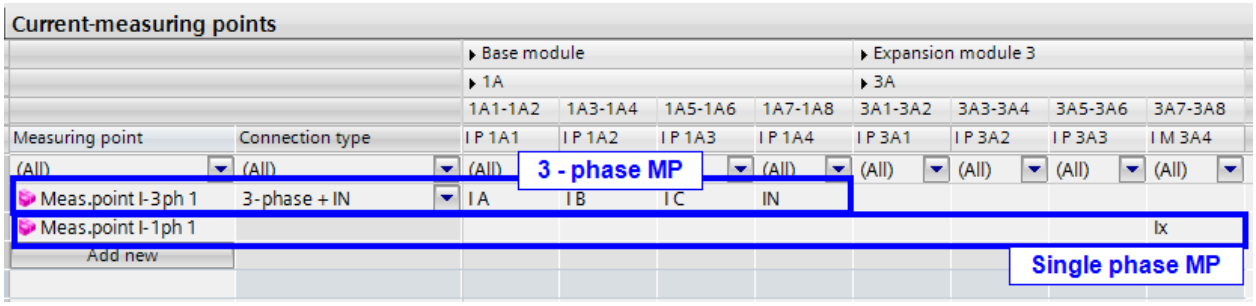
A characteristic of the conditions described above is a strong presence of 2nd harmonic component in the measured residual current. This application note will describe a method that can be applied to block the sensitive 3I0-stages with 2nd harmonic current detection.

1.2 2nd harmonic detection

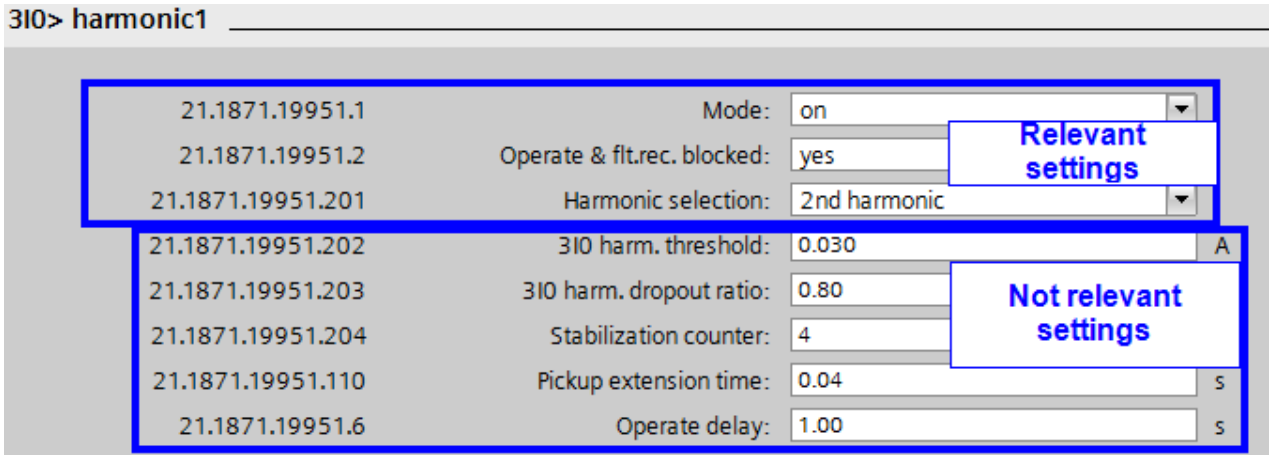
The following protection stage will be applied for 2nd harmonic detection (here shown in the FG Line of 7SL86):



The 3I0> harmonic function is applied to the 3I0 current as it is measured. For the FG line it is a 3phase measuring point alternatively a FG VI 1ph could use a single phase measuring point:



1.2.1 Setting options



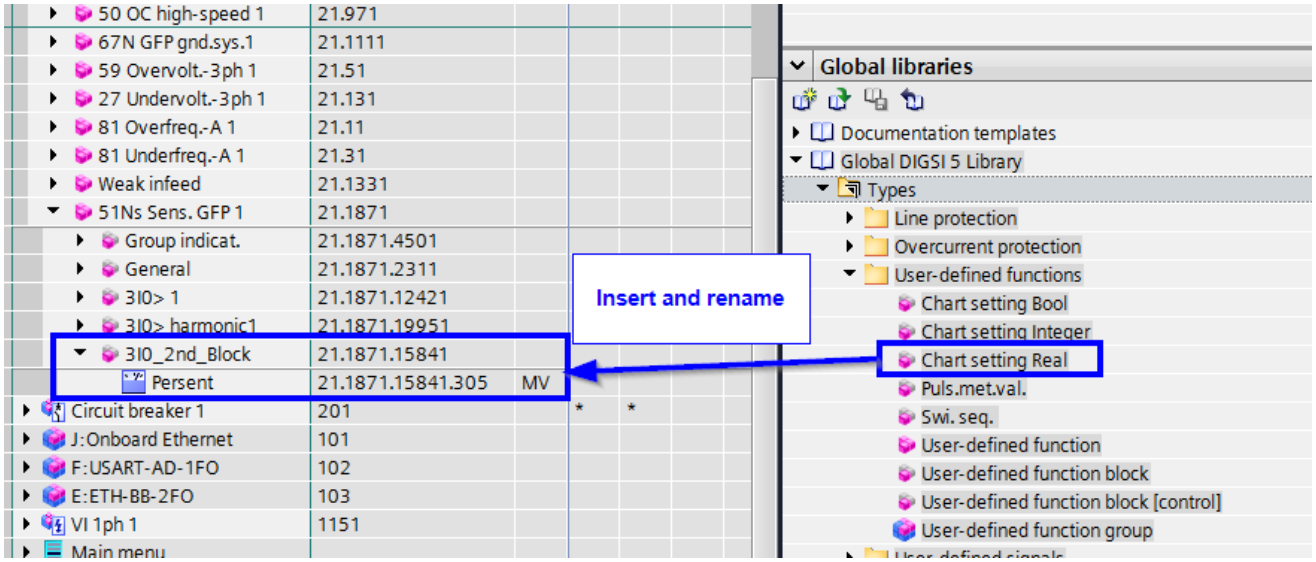
Above the setting options are shown. As the blocking will be derived via CFC logic with the 2nd harmonic measured value, the only relevant settings for this application are:

Mode:	on
Operate & flt.rec.blocked:	yes (this function will not be used for tripping)
Harmonic selection:	2nd harmonic

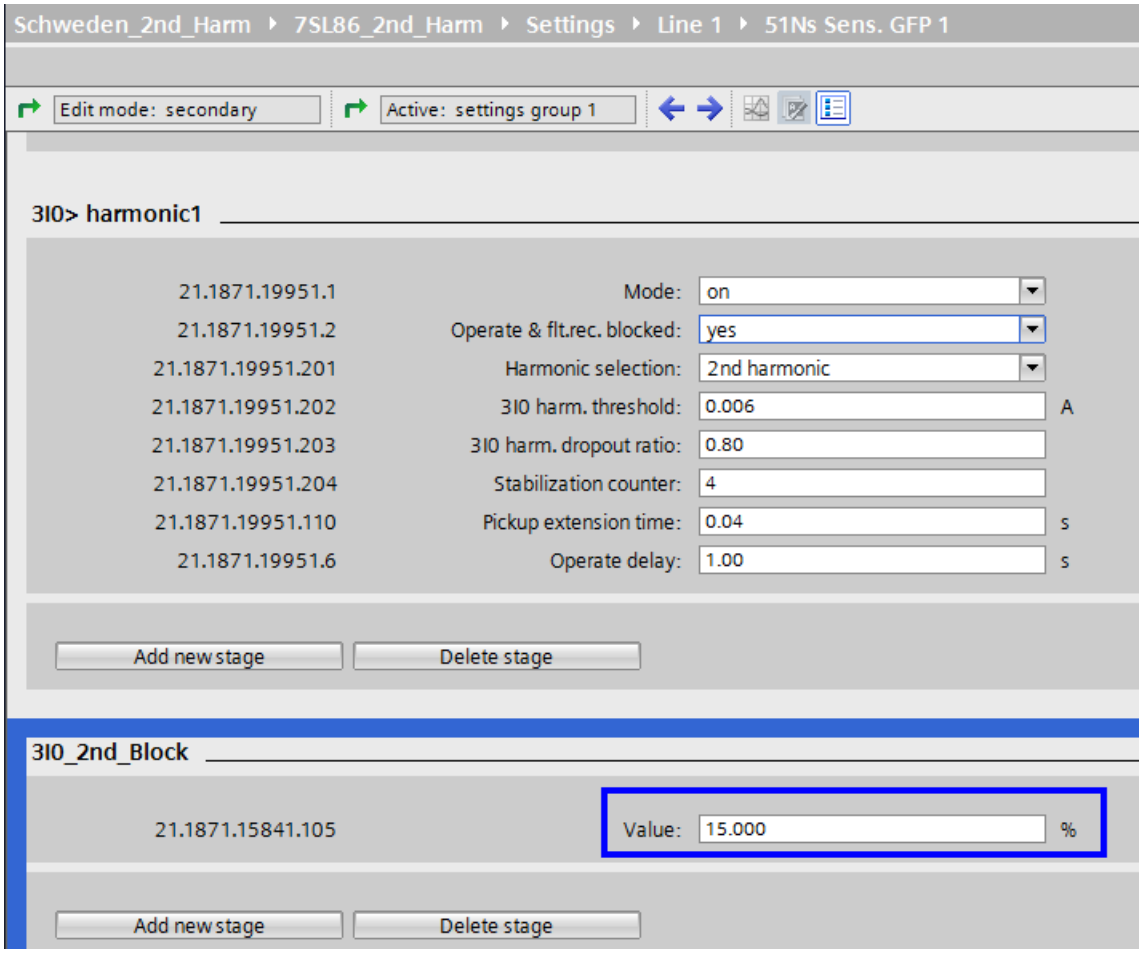
1.2.2 Percentage restraint – user defined setting parameter

Blocking with the 2nd harmonic component must be applied in the form of a percentage restraint. For this purpose, the following is required.

For the setting value of the restraint (e.g. 15%) a chart setting value from the library as shown below must be inserted, and may then be renamed as desired:

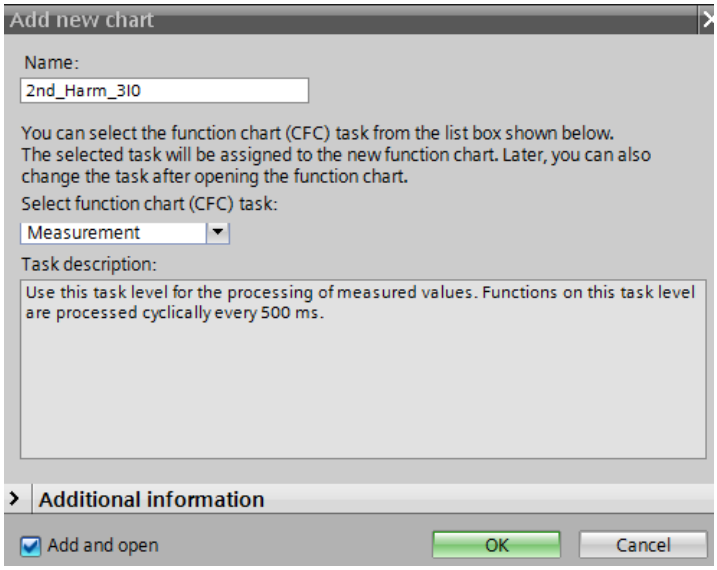


The setting value can then be applied in the function as follows:

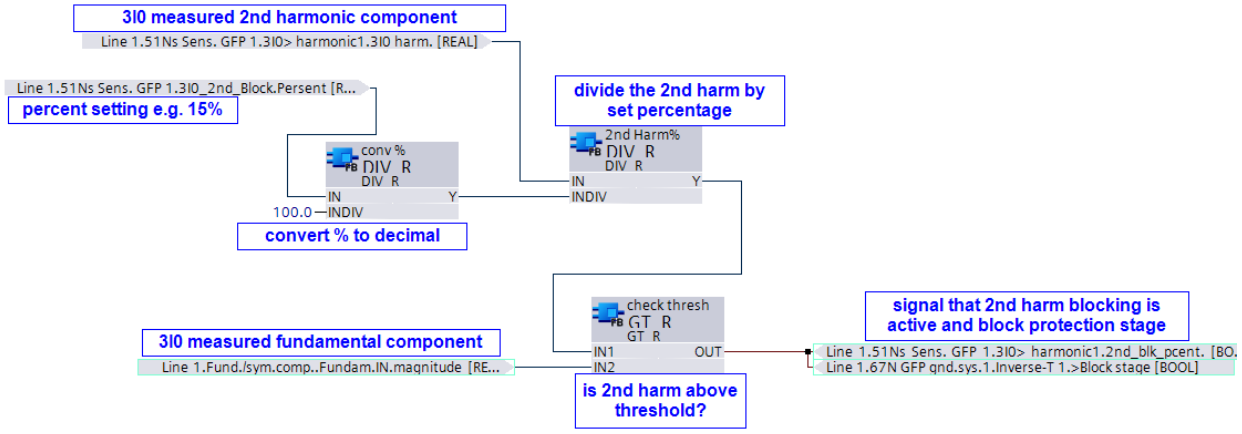


1.2.3 CFC Logic

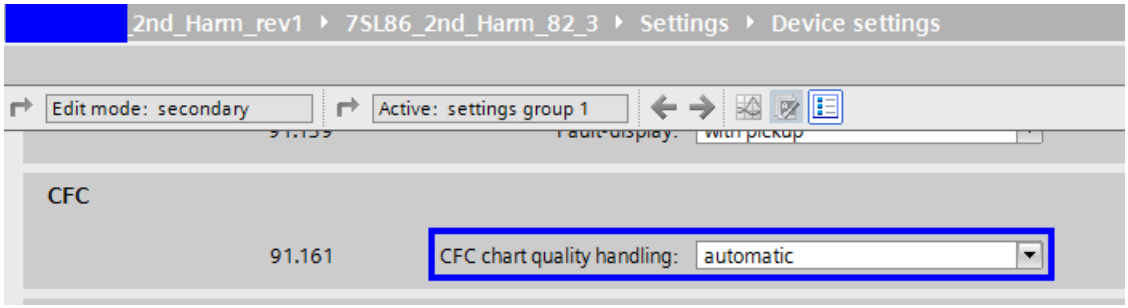
A CFC logic will be required to derive the blocking signal. (optional additional signals may be applied to obtain entries in the logs/recorders when the blocking is active – in this example user defined signals are applied for this purpose)



The chart is applied in the "Measurement" task as measured values will be processed.



The CFC chart quality handling is done automatically by default. If the setting under device settings shown below is changed to manual, the CFC chart above must be extended to prevent the blocking output when the measured values are invalid:



With the above logic the 15% chart setting value is converted to a factor = 0.15. This factor is then used to make the measured 2nd harmonic comparable with the measured 3I0 (use the fundamental component). If the harmonic is above 15% the output indicates this and in turn will block the 67N or other 3I0 protection stages that have their blocking input routed here.

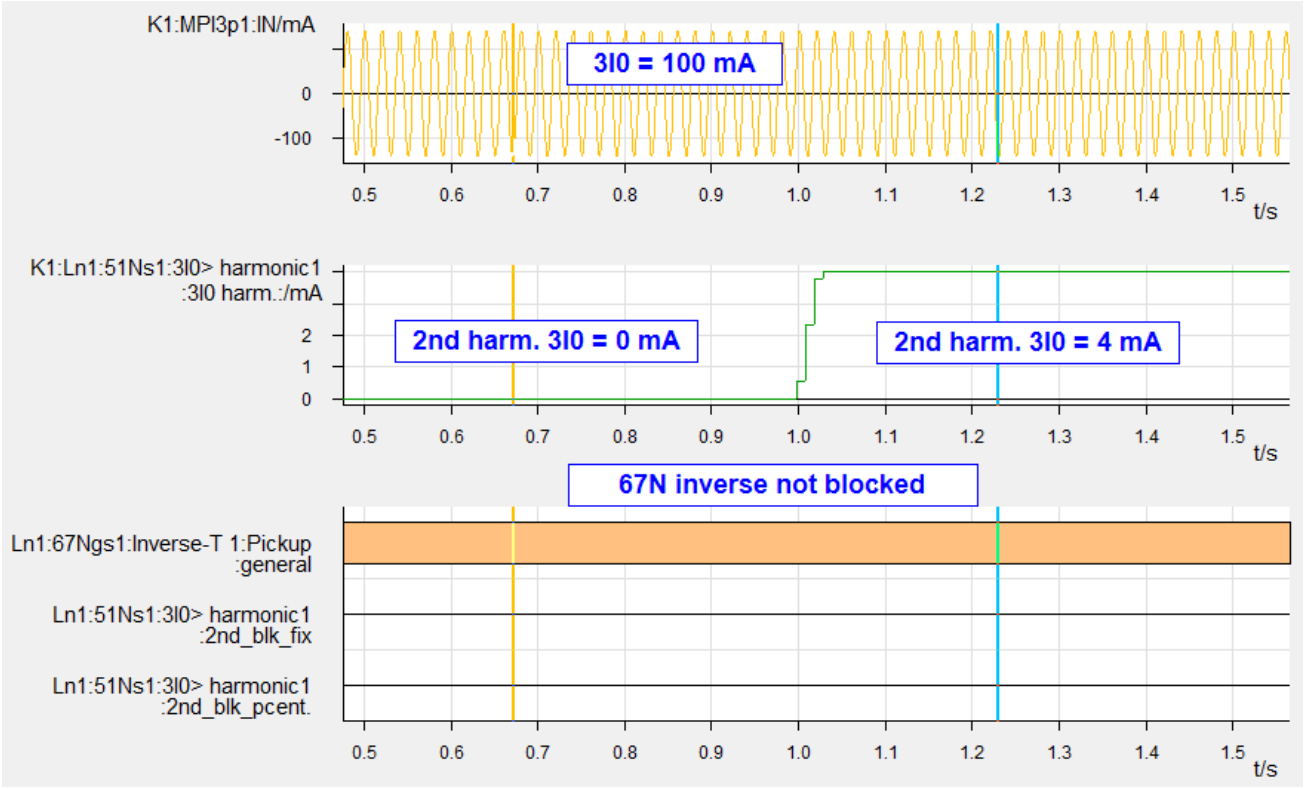
1.3 Test Cases

1.3.1 Case 1 – 2nd harmonic 4 mA

The following conditions apply:

Current	Mag	2nd Harm %	2nd Harm mA
IA	0,8	0,5%	4 mA
IB	0,7	0 %	
IC	0,7	0 %	
3I0	0,1	4 %	4 mA

There should be no blocking of the 67N stage as the harmonic component is only 4%:

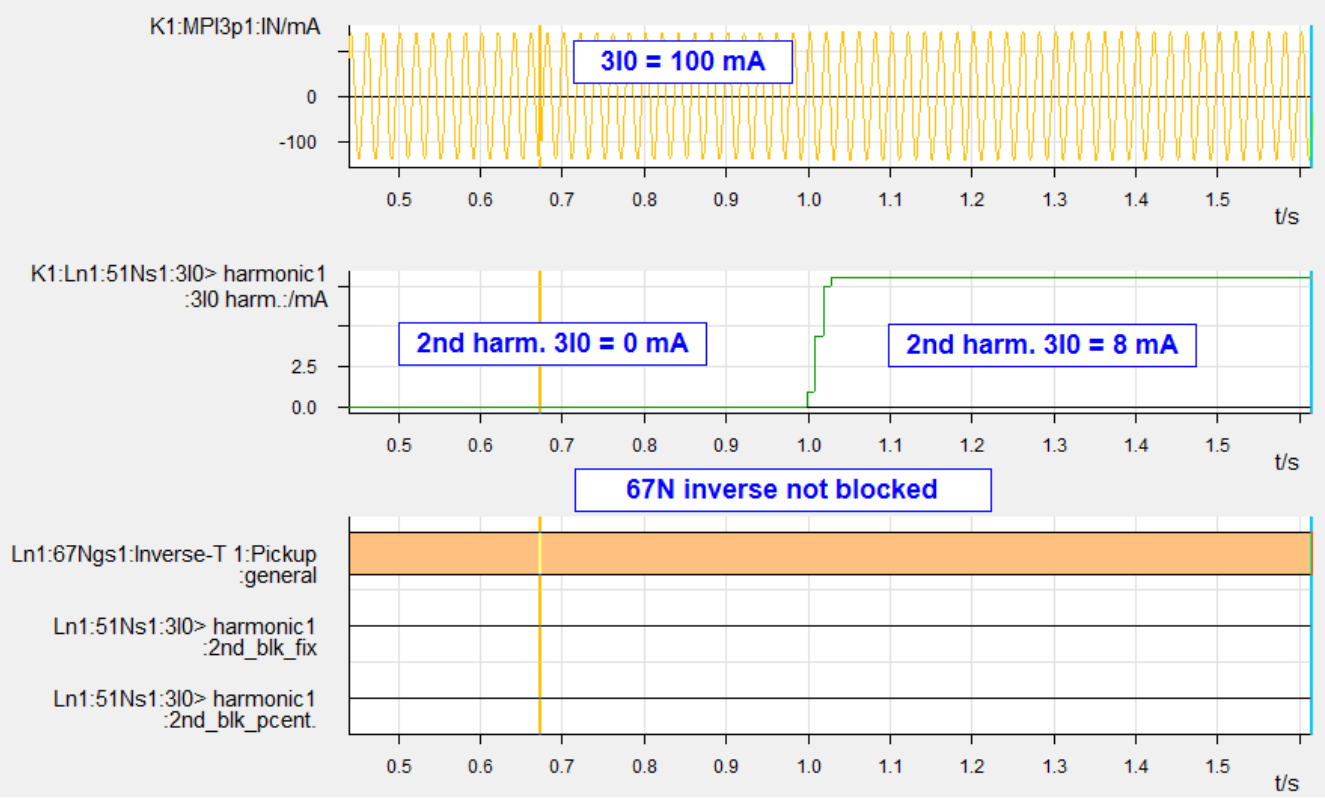


1.3.2 Case 2 – 2nd harmonic 8 mA but below 15%

The following conditions apply:

Current	Mag	2nd Harm %	2nd Harm mA
IA	0,8	1%	8 mA
IB	0,7	0 %	
IC	0,7	0 %	
3I0	0,1	8 %	8 mA

There should be no blocking of the 67N stage as the harmonic component is only 8%:

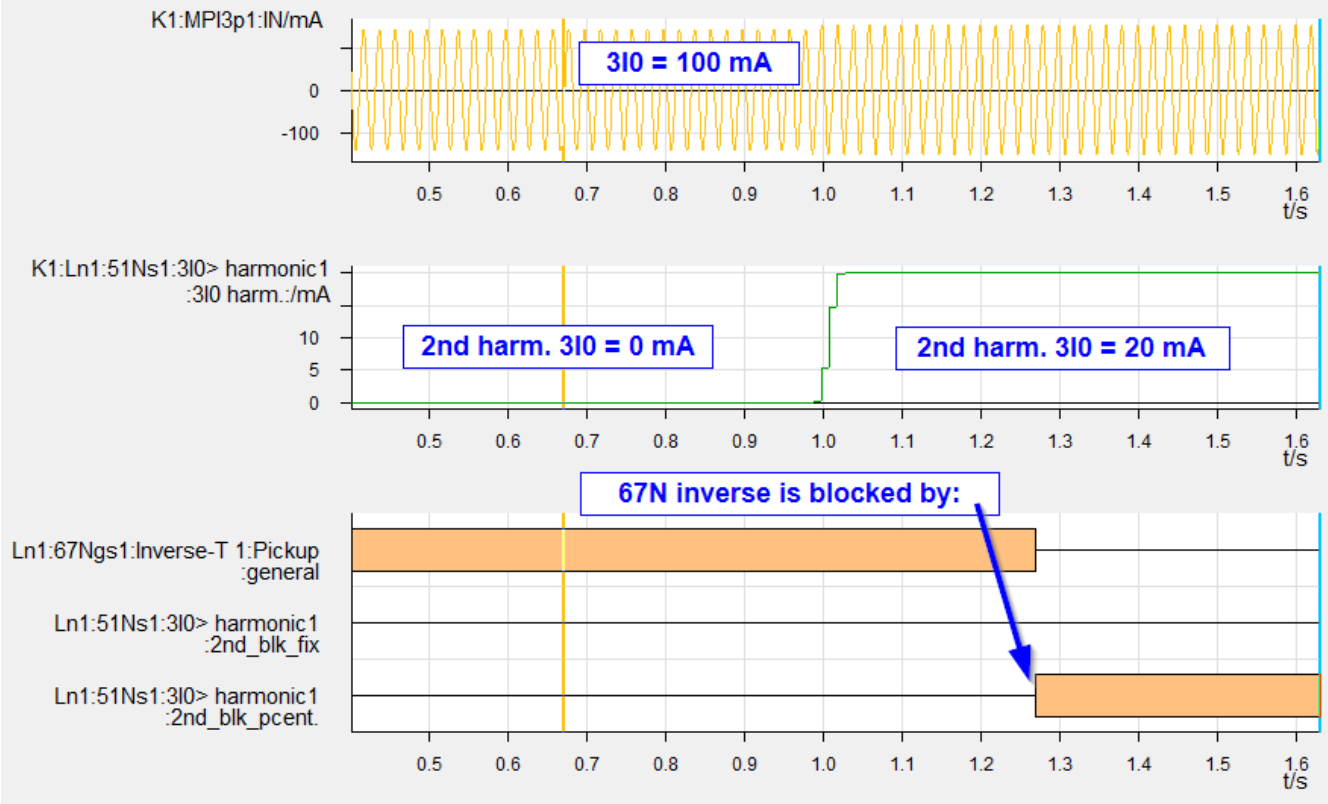


1.3.3 Case 3 – 2nd harmonic 20 mA and 20%

The following conditions apply:

Current	Mag	2nd Harm %	2nd Harm mA
IA	0,8	2,5%	20 mA
IB	0,7	0 %	
IC	0,7	0 %	
3I0	0,1	20 %	20 mA

There should be blocking of the 67N stage as the harmonic component is above 15%:

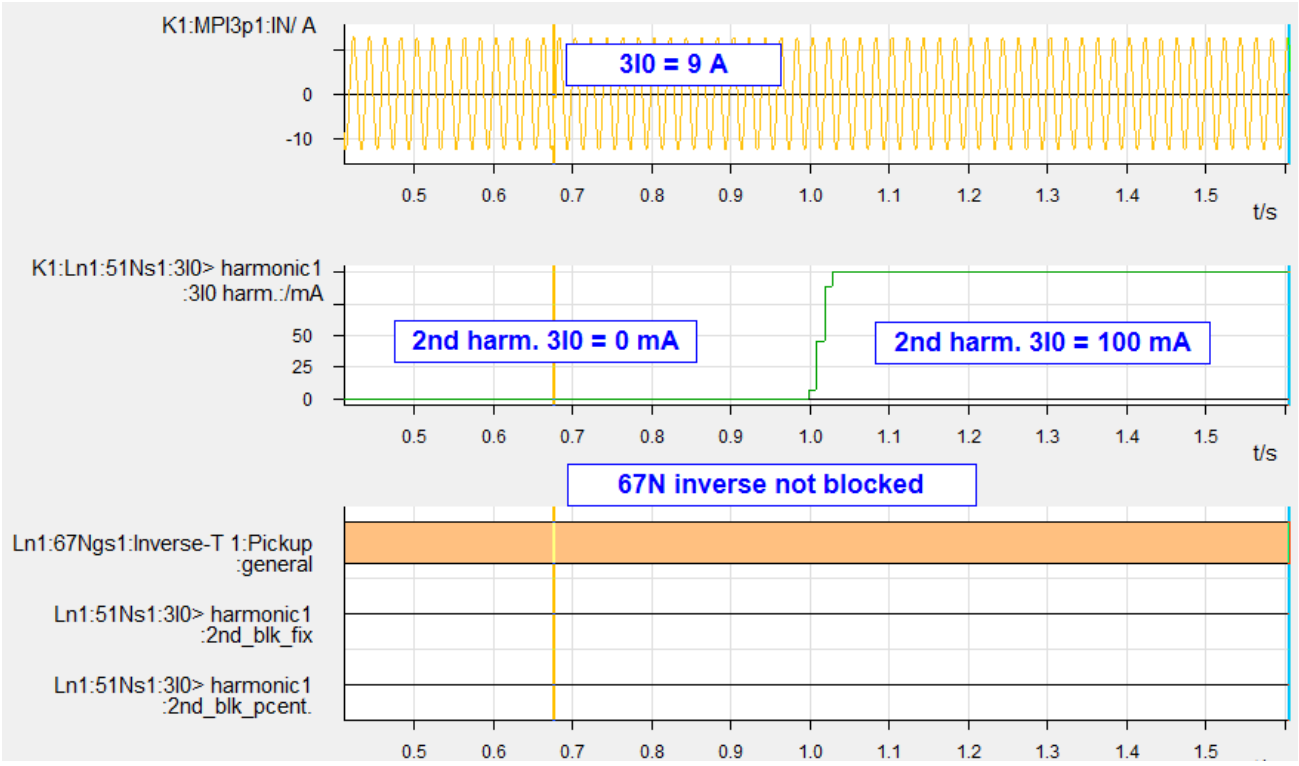


1.3.4 Case 4 –3I0 = 9A and 2nd harmonic 100 mA

The following conditions apply:

Current	Mag	2nd Harm %	2nd Harm mA
IA	10	1%	100 mA
IB	1	0 %	
IC	1	0 %	
3I0	9	1,1 %	100 mA

There should be no blocking of the 67N stage as the harmonic component is only 1.1%:

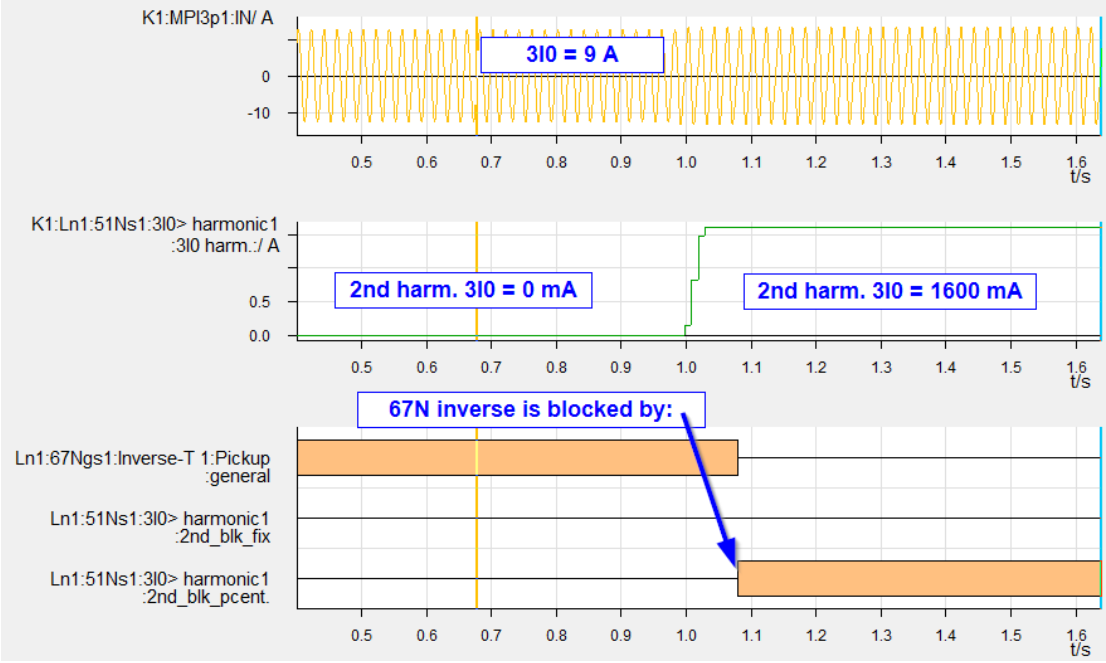


1.3.5 Case 5 – 3I0 = 9A and 2nd harmonic 1600 mA %

The following conditions apply:

Current	Mag	2nd Harm %	2nd Harm mA
IA	10	16%	1600 mA
IB	1	0 %	
IC	1	0 %	
3I0	9	17,8 %	1600 mA

There should be blocking of the 67N stage as the harmonic component is above 15%:



1.4 Conclusion

The functional measured value (3I0 harmonic) applied via CFC is very effective as blocking criterium for sensitive 3I0 stages in the presence of non-linear disruptions of primary or secondary systems.

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