YASKAWA
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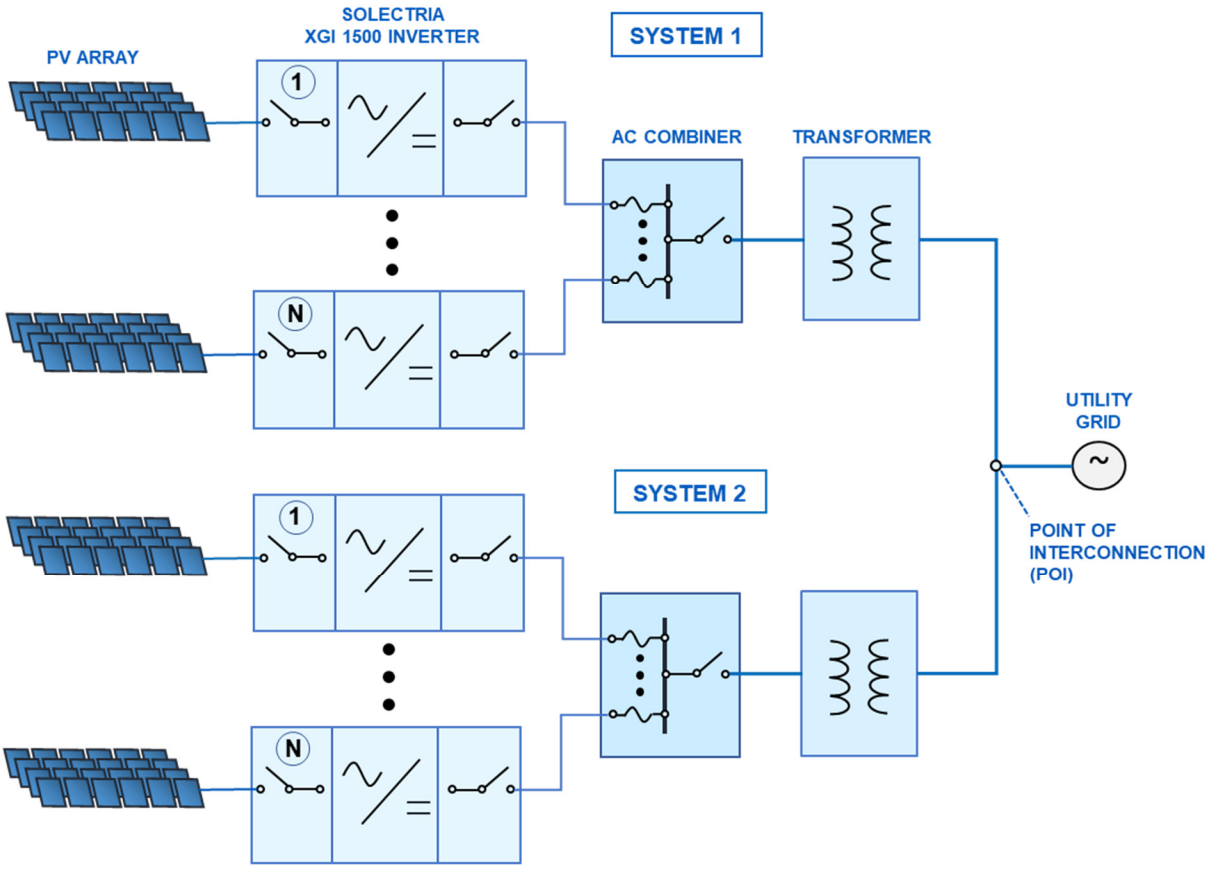
SOLECTRIA® XGI 1500 Inverter Configuration Limits with Low Grid SCR Values

For proper and trouble-free operation, the number of XGI 1500 inverters that can be connected to the grid at a single point of interconnection (POI) is limited in circumstances where the grid has a very low SCR value. At very low SCR values, resonance on the AC voltage waveform can occur, owing to the combination of the impedances of the inverters, transformer and grid. When sufficient AC voltage resonance occurs, the XGI 1500 inverter will detect the grid AC voltage as too high and will shut down safely. Field experience, analysis and laboratory testing have led to the following guidelines for proper configuration of XGI 1500 inverters with a common POI.

Note the simplified diagram below, showing a number (N) of XGI 1500 inverters with their AC output wired to and connected in parallel at an AC combiner. The combined AC output from the AC combiner connects to a transformer; the transformer output connects to the grid at the Point of Interconnection (POI). Two similar systems are shown, and both connect to the grid at the same POI. Note in the analysis that follows, up to three systems may be required at a single point of interconnection.



The following tables correspond to specific short-circuit ratio (SCR) scenarios, covering values from 2.0 to 6.0. To use the tables, first select the one matching the desired SCR. Then locate the row corresponding to the target system size (in MW). Each table provides the required number of systems, along with the allowable range of inverters per system, to avoid potential resonance issues.

SCR AT POINT OF INTERCONNECTION (POI) 2.0

INVERTER XGI 1500-250/250-600 0.250MW

Rated Power (MW)	Total # Inverters	INVERTERS PER SYSTEM					
		SYSTEM 1		SYSTEM 2		SYSTEM 3	
		Min	Max	Min	Max	Min	Max
0.25 - 1.25	1 - 5	1	5	X	X	X	X
1.50	6	1	5	1	5	X	X
1.75	7	2	5	2	5	X	X
2.00	8	3	5	3	5	X	X
2.25	9	3	6	3	6	X	X
2.50	10	4	6	4	6	X	X
2.75	11	4	7	4	7	X	X
3.00	12	4	7	4	7	X	X
3.25	13	6	7	6	7	X	X
3.50	14	7		7		X	X
3.75	15	1	7	1	7	1	7
4.00	16	8		8		X	X
4.25	17	1	8	1	8	1	8
4.50	18	9		9		X	X
4.75	19	1	9	1	9	1	9
5.00	20	10		10		X	X
5.25	21	1	10	1	10	1	10
5.50	22	2	10	2	10	2	10
5.75	23	3	10	3	10	3	10
6.00	24	4	10	4	10	4	10
6.25	25	5	10	5	10	5	10
6.50	26	6	10	6	10	6	10
6.75	27	7	10	7	10	7	10
7.00	28	6	11	6	11	6	11
7.25	29	7	11	7	11	7	11
7.50	30	6	12	6	12	6	12
7.75	31	7	12	7	12	7	12
8.00	32	8	12	8	12	8	12
8.25	33	7	13	7	13	7	13
8.50	34	8	13	8	13	8	13
8.75	35	7	14	7	14	7	14
9.00	36	8	14	8	14	8	14
9.25	37	9	14	9	14	9	14
9.50	38	8	15	8	15	8	15
9.75	39	9	15	9	15	9	15
10.0	40	8	16	8	16	8	16

SCR AT POINT OF INTERCONNECTION (POI)								2.5
INVERTER XGI 1500-250/250-600 0.250MW								
Rated Power (MW)	Total # Inverters	INVERTERS PER SYSTEM						
		SYSTEM 1		SYSTEM 2		SYSTEM 3		
		Min	Max	Min	Max	Min	Max	
0.25 - 1.25	1 - 5	1	5	X	X	X	X	
1.50	6	1	5	1	5	X	X	
1.75	7	2	5	2	5	X	X	
2.00	8	2	6	2	6	X	X	
2.25	9	2	7	2	7	X	X	
2.50	10	3	7	3	7	X	X	
2.75	11	4	7	4	7	X	X	
3.00	12	5	7	5	7	X	X	
3.25	13	5	8	5	8	X	X	
3.50	14	6	8	6	8	X	X	
3.75	15	6	9	6	9	X	X	
4.00	16	6	10	6	10	X	X	
4.25	17	7	10	7	10	X	X	
4.50	18	8	10	8	10	X	X	
4.75	19	9	10	9	10	X	X	
5.00	20	10		10		X	X	
5.25	21	1	10	1	10	1	10	
5.50	22	11		11		X	X	
5.75	23	1	11	1	11	1	11	
6.00	24	12		12		X	X	
6.25	25	1	12	1	12	1	12	
6.50	26	13		13		X	X	
6.75	27	1	13	1	13	1	13	
7.00	28	14		14		X	X	
7.25	29	1	14	1	14	1	14	
7.50	30	15		15		X	X	
7.75	31	1	15	1	15	1	15	
8.00	32	16		16		X	X	
8.25	33	1	16	1	16	X	X	
8.50	34	17		17		X	X	
8.75	35	1	17	1	17	1	17	
9.00	36	2	17	2	17	2	17	
9.25	37	3	17	3	17	3	17	
9.50	38	4	17	4	17	4	17	
9.75	39	5	17	5	17	5	17	
10.0	40	6	17	6	17	6	17	

SCR AT POINT OF INTERCONNECTION (POI) 3.0

INVERTER XGI 1500-250/250-600 0.250MW

Rated Power (MW)	Total # Inverters	INVERTERS PER SYSTEM					
		SYSTEM 1		SYSTEM 2		SYSTEM 3	
		Min	Max	Min	Max	Min	Max
0.25 - 1.75	1 - 7	1	7	X	X	X	X
2.00	8	1	7	1	7	X	X
2.25	9	2	7	2	7	X	X
2.50	10	3	7	3	7	X	X
2.75	11	4	7	4	7	X	X
3.00	12	3	9	3	9	X	X
3.25	13	4	9	4	9	X	X
3.50	14	4	10	4	10	X	X
3.75	15	5	10	5	10	X	X
4.00	16	6	10	6	10	X	X
4.25	17	7	10	7	10	X	X
4.50	18	8	10	8	10	X	X
4.75	19	8	11	8	11	X	X
5.00	20	8	12	8	12	X	X
5.25	21	9	12	9	12	X	X
5.50	22	9	13	9	13	X	X
5.75	23	10	13	10	13	X	X
6.00	24	10	14	10	14	X	X
6.25	25	10	15	10	15	X	X
6.50	26	11	15	11	15	X	X
6.75	27	11	16	11	16	X	X
7.00	28	12	16	12	16	X	X
7.25	29	12	17	12	17	X	X
7.50	30	13	17	13	17	X	X
7.75	31	14	17	14	17	X	X
8.00	32	15	17	15	17	X	X
8.25	33	16	17	16	17	X	X
8.50	34	17		17		X	X
8.75	35	1	17	1	17	1	17
9.00	36	18		18		X	X
9.25	37	1	18	1	18	1	18
9.50	38	19		19		X	X
9.75	39	1	19	1	19	1	19
10.0	40	20		20		X	X

SCR AT POINT OF INTERCONNECTION (POI) 4.0

INVERTER XGI 1500-250/250-600 0.250MW

Rated Power (MW)	Total # Inverters	INVERTERS PER SYSTEM					
		SYSTEM 1		SYSTEM 2		SYSTEM 3	
		Min	Max	Min	Max	Min	Max
0.25 - 1.75	1 - 7	1	7	X	X	X	X
2.00	8	8		X	X	X	X
2.25	9	9		X	X	X	X
2.50	10	10		X	X	X	X
2.75	11	1	10	1	10	X	X
3.00	12	2	10	2	10	X	X
3.25	13	3	10	3	10	X	X
3.50	14	3	11	3	11	X	X
3.75	15	3	12	3	12	X	X
4.00	16	4	12	4	12	X	X
4.25	17	4	13	4	13	X	X
4.50	18	4	14	4	14	X	X
4.75	19	4	15	4	15	X	X
5.00	20	4	16	4	16	X	X
5.25	21	5	16	5	16	X	X
5.50	22	5	17	5	17	X	X
5.75	23	6	17	6	17	X	X
6.00	24	7	17	7	17	X	X
6.25	25	8	17	8	17	X	X
6.50	26	9	17	9	17	X	X
6.75	27	9	18	9	18	X	X
7.00	28	10	18	10	18	X	X
7.25	29	10	19	10	19	X	X
7.50	30	10	20	10	20	X	X
7.75	31	11	20	11	20	X	X
8.00	32	12	20	12	20	X	X
8.25	33	13	20	13	20	X	X
8.50	34	14	20	14	20	X	X
8.75	35	15	20	15	20	X	X
9.00	36	16	20	16	20	X	X
9.25	37	17	20	17	20	X	X
9.50	38	18	20	18	20	X	X
9.75	39	19	20	19	20	X	X
10.0	40	20		20		X	X

SCR AT POINT OF INTERCONNECTION (POI)								5.0
INVERTER XGI 1500-250/250-600 0.250MW								
Rated Power (MW)	Total # Inverters	INVERTERS PER SYSTEM						
		SYSTEM 1		SYSTEM 2		SYSTEM 3		
		Min	Max	Min	Max	Min	Max	
0.25 - 1.75	1 - 7	1	7	X	X	X	X	
2.00 - 2.75	8 - 11	8	11	X	X	X	X	
3.00 - 3.75	12 - 15	12	15	X	X	X	X	
4.00	16	16		X	X	X	X	
4.25	17	17		X	X	X	X	
4.50	18	1	17	1	17	X	X	
4.75	19	2	17	2	17	X	X	
5.00	20	3	17	3	17	X	X	
5.25	21	4	17	4	17	X	X	
5.50	22	4	18	4	18	X	X	
5.75	23	4	19	4	19	X	X	
6.00	24	4	20	4	20	X	X	
6.25	25	5	20	5	20	X	X	
6.50	26	6	20	6	20	X	X	
6.75	27	7	20	7	20	X	X	
7.00	28	8	20	8	20	X	X	
7.25	29	9	20	9	20	X	X	
7.50	30	10	20	10	20	X	X	
7.75	31	11	20	11	20	X	X	
8.00	32	12	20	12	20	X	X	
8.25	33	13	20	13	20	X	X	
8.50	34	14	20	14	20	X	X	
8.75	35	15	20	15	20	X	X	
9.00	36	16	20	16	20	X	X	
9.25	37	17	20	17	20	X	X	
9.50	38	18	20	18	20	X	X	
9.75	39	19	20	19	20	X	X	
10.0	40	20	20	20	20	X	X	

SCR AT POINT OF INTERCONNECTION (POI)								6.0
INVERTER XGI 1500-250/250-600 0.250MW								
Rated Power (MW)	Total # Inverters	INVERTERS PER SYSTEM						
		SYSTEM 1		SYSTEM 2		SYSTEM 3		
		Min	Max	Min	Max	Min	Max	
0.25 - 1.75	1 - 7	1	7	X	X	X	X	
2.00 - 2.75	8 - 11	8	11	X	X	X	X	
3.00 - 3.75	12 - 15	12	15	X	X	X	X	
4.00 - 4.75	16 - 19	16	19	X	X	X	X	
5.00	20	20		X	X	X	X	
5.25	21	1	20	1	20	X	X	
5.50	22	2	20	2	20	X	X	
5.75	23	3	20	3	20	X	X	
6.00	24	4	20	4	20	X	X	
6.25	25	5	20	5	20	X	X	
6.50	26	6	20	6	20	X	X	
6.75	27	7	20	7	20	X	X	
7.00	28	8	20	8	20	X	X	
7.25	29	9	20	9	20	X	X	
7.50	30	10	20	10	20	X	X	
7.75	31	11	20	11	20	X	X	
8.00	32	12	20	12	20	X	X	
8.25	33	13	20	13	20	X	X	
8.50	34	14	20	14	20	X	X	
8.75	35	15	20	15	20	X	X	
9.00	36	16	20	16	20	X	X	
9.25	37	17	20	17	20	X	X	
9.50	38	18	20	18	20	X	X	
9.75	39	19	20	19	20	X	X	
10.0	40	20	20	20	20	X	X	

Examples

These examples are intended to illustrate how to interpret the tables.

Example 1

Assume the following:

- Site SCR is specified at: 2.5
- Desired system size is: 3.0MW

SCR AT POINT OF INTERCONNECTION (POI)							2.5
INVERTER XGI 1500-250/250-600 0.250MW							
Rated Power (MW)	Total # Inverters	INVERTERS PER SYSTEM					
		SYSTEM 1		SYSTEM 2		SYSTEM 3	
		Min	Max	Min	Max	Min	Max
0.25 - 1.25	1 - 5	1	5	X	X	X	X
1.50	6	1	5	1	5	X	X
1.75	7	2	5	2	5	X	X
2.00	8	2	6	2	6	X	X
2.25	9	2	7	2	7	X	X
2.50	10	3	7	3	7	X	X
2.75	11	4	7	4	7	X	X
3.00	12	5	7	5	7	X	X

Results

- 12 inverters required (XGI 1500-250/250-600)
- Two separate systems are required (System 1 and System 2)
- A third system is not required, as indicated by the “X” entries
- The number of inverters in each system can be 5, 6 or 7.
- The total of the number of inverters, that is those in System 1 plus those in System 2, must equal 12.
- The two solutions are:

One System # inverters	The Other System # inverters
5	7
6	6

Example 2

Assume the following:

- Site SCR is specified at: 2.0
- Desired system size is: 3.75MW

SCR AT POINT OF INTERCONNECTION (POI)								2.0
INVERTER XGI 1500-250/250-600 0.250MW								
Rated Power (MW)	Total # Inverters	INVERTERS PER SYSTEM						
		SYSTEM 1		SYSTEM 2		SYSTEM 3		
		Min	Max	Min	Max	Min	Max	
0.25 - 1.25	1 - 5	1	5	X	X	X	X	
1.50	6	1	5	1	5	X	X	
1.75	7	2	5	2	5	X	X	
2.00	8	3	5	3	5	X	X	
2.25	9	3	6	3	6	X	X	
2.50	10	4	6	4	6	X	X	
2.75	11	4	7	4	7	X	X	
3.00	12	4	7	4	7	X	X	
3.25	13	6	7	6	7	X	X	
3.50	14	7		7		X	X	
3.75	15	1	7	1	7	1	7	

Results

- 15 inverters required (XGI 1500-250/250-600)
- Three separate systems are required (Systems 1, 2 and 3)
- The number of inverters in each system can be any number between 1 and 7
- The total of the number of inverters must equal 15.
- The seven solutions are:

One System # inverters	Another System # inverters	Last System # inverters
1	7	7
2	6	7
3	5	7
3	6	6
4	4	7
4	5	6
5	5	5

Contact appeng@solectria.com with any questions.