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Register court: Amtsgericht Kassel HRB 3972
Chairman of the Supervisory Board: Günther Cramer
Managing Board: Jürgen Dolle, Roland Grebe, Pierre-Pascal Urbon, Marko Werner

Certificate G59/2

Engineering Recommendation

Manufacturer	**SMA Solar Technology AG**
Address	Sonnenallee 1
Postal code, place	34266 Niestetal
Country	Germany

Test house details	**SMA Solar Technology AG**

Type reference	Max. AC power	Nominal AC power
STP 15000TLEE-10	15,000 VA	15,000 W
STP 15000TLHE-10	15,000 VA	15,000 W
STP 20000TLEE-10	20,000 VA	20,000 W
STP 20000TLHE-10	20,000 VA	20,000 W

The results of the G59/2 tests are summarized in this certificate. SMA declares that all devices (with G59 setting) that are shipped to the UK comply with the requirements defined in engineering recommendation G59/2. These settings cannot be changed by an installer, user or by any other person without the use of a tool (password protected).
The complete documentation can be viewed at SMA (headquarters) after prior announcement.

SMA Solar Technology AG
Niestetal, 2012-07-03

ppa. Frank Greizer

ppa. Frank Greizer
(Vice President MP T PD)

Test Results

Power Quality

Harmonic current emissions as per BS EN 61000-3-12										
Minimal Short Circuit Ratio R_{SCE}								33		
Value of Short Circuit Power S_{SC} corresponding to R_{SCE}					STP 15000TLEE-10			0.495 MVA		
					STP 15000TLHE-10			0.495 MVA		
					STP 20000TLEE-10			0.660 MVA		
					STP 20000TLHE-10			0.660 MVA		
Description			Harmonic current % = 100 I_n/I_1						Harmonic current distortion factors (%)	
Harmonic			3rd	5th	7th	9th	11th	13th	THD	PWHD
Limit BS EN 61000-3-12 Table 2 - 4			21.6	10.7	7.2	3.8	3.1	2	23 (13)	23 (22)
	STP 15000TLEE-10	L1	0.14	0.33	0.22	0.06	0.26	0.24	0.75	1.73
		L2	0.11	0.35	0.26	0.05	0.25	0.25	0.72	1.76
		L3	0.07	0.34	0.25	0.05	0.26	0.25	0.70	1.76
	STP 15000TLHE-10	L1	0.11	0.65	0.45	0.07	0.26	0.32	1.11	2.10
		L2	0.18	0.52	0.44	0.07	0.34	0.28	1.00	2.22
		L3	0.21	0.48	0.41	0.07	0.31	0.32	1.01	2.14
	STP 20000TLEE-10	L1	0.2	0.24	0.16	0.05	0.18	0.22	0.65	1.62
		L2	0.17	0.30	0.23	0.04	0.17	0.23	0.65	1.70
		L3	0.05	0.24	0.23	0.04	0.17	0.23	0.61	1.70
	STP 20000TLHE-10	L1	0.09	0.64	0.41	0.05	0.26	0.28	1.08	1.92
		L2	0.08	0.54	0.37	0.06	0.27	0.26	0.89	1.97
		L3	0.15	0.48	0.37	0.05	0.24	0.27	1.02	1.94

Voltage fluctuations and flicker				
	Starting	Stopping	Running (at rated power)	
BS EN 61000-3-3 Limit	4%	4%	P_{st} = 1.0	P_{lt} = 0.65
Test value	0.34%	0.28%	0.09	0.09

DC injection			
G59/2 Limit	20 mA		
Test level (% of rated power)	10%	55%	100%
Test value	12.3 mA	14.4 mA	18.6 mA

Power factor			
G59/2 Limit	0.95 lag – 0.95 lead		
Test level (AC voltage)	212 V	230 V	248 V
Test value (at rated power)	> 0.99	> 0.99	> 0.99

Overvoltage/Undervoltage

Overvoltage test						
	G59/2 Limit		Setting		Test results	
Overvoltage stage 1	Voltage	Time	Voltage	Time	Voltage	Time
L1 - N	264 V	1 s	264 V	1 s	261.5 V	0.97 s
L2 - N					261.1 V	0.97 s
L3 - N					261.6 V	0.98 s
L1 - L2	456.5 V	1 s	456.5 V	1 s	453.1 V	0.97 s
L1 - L3					452.2 V	0.97 s
L2 - L3					452.2 V	0.97 s
Overvoltage stage 2	Voltage	Time	Voltage	Time	Voltage	Time
L1 - N	276 V	0.5 s	276 V	0.5 s	272.9 V	0.03 s
L2 - N					272.6 V	0.05 s
L3 - N					273.6 V	0.48 s
L1 - L2	477.3 V	0.5 s	477.3 V	0.5 s	471.9 V	0.03 s
L1 - L3					472.8 V	0.48 s
L2 - L3					471.9 V	0.11 s

Undervoltage test						
	G59/2 Limit		Setting		Test results	
Undervoltage stage 1	Voltage	Time	Voltage	Time	Voltage	Time
L1 - N	208.8 V	2.5 s	208.8 V	2.5 s	211.2 V	2.46 s
L2 - N					210.8 V	2.46 s
L3 - N					211.2 V	2.48 s
L1 - L2	361.1 V	2.5 s	361.1 V	2.5 s	365.8 V	2.46 s
L1 - L3					365.9 V	2.46 s
L2 - L3					365.9 V	2.47 s
Undervoltage stage 2	Voltage	Time	Voltage	Time	Voltage	Time
L1 - N	192 V	0.5 s	192 V	0.5 s	194.8 V	0.48 s
L2 - N					193.7 V	0.48 s
L3 - N					194.3 V	0.48 s
L1 - L2	332 V	0.5 s	332 V	0.5 s	336.4 V	0.48 s
L1 - L3					336.2 V	0.48 s
L2 - L3					336.7 V	0.48 s

Under/Over Frequency

Under/over frequency test						
	G59/2 Limit		Setting		Test results	
	Frequency	Time	Frequency	Time	Frequency	Time
Under frequency stage 1	47.5 Hz	20 s	47.5 Hz	20 s	47.56 Hz	19.96 s
Under frequency stage 2	47 Hz	0.5 s	47 Hz	0.5 s	47.06 Hz	0.48 s
Over frequency stage 1	51.5 Hz	90 s	51.5 Hz	90 s	51.48 Hz	89.93 s
Over frequency stage 2	52 Hz	0.5 s	52 Hz	0.5 s	51.96 Hz	0.48 s

Loss of Mains Tests

Loss of mains tests (method used: frequency shift)			
Test level (% of rated power)	10%	55%	100%
G59/2 Limit	2.5 s	2.5 s	2.5 s
Actual setting	1.0 s	1.0 s	1.0 s
Trip value	0.24 s	0.52 s	0.26 s

Reconnection Times

Reconnection times			
Test level (% of rated power)	Undervoltage/overvoltage	Under/over frequency	Loss of mains
G59/2 Limit	180 s	180 s	180 s
Actual setting	180 s	180 s	180 s
Recorded value	184 s	200 s	184 s

Fault Level Contribution

As SSEGs (small-scale embedded generators) for PV are inverter-connected, they are deemed to automatically comply with regulations and no further tests are required.

Self Monitoring – Solid State Switching

Not applicable as electro-mechanical relays used.