



Enhancing distribution hosting capacity in urban microgrids: A coordinated DSM and storage framework for Wellington's Kilbirnie network Supplementary Material

Area of study



Kilbirnie area (-41.32161133291265, 174.79636296119415)

PV and BESS Configuration for Each Microgrid

Transformers Name	Purpose	Total PV Capacity	Total BESS Capacity
TS_1944	Retirement Home	166.4 KW	0.2 MWH
TS_2702	Bus Depot	832 KW	2 MWH
TS_2415	Bus Depot		
SO_473	Bus Depot and Residential	172.8 KW (Residential)	2.03 MWH
SO_177	Residential	560.64 KW	6.59 MWH
TS_2036	Residential	480 KW	5.6 MWH

Components Used in Simulation.

- PV Module
 - LR8-66HVD 640~665M

Electrical Characteristics	STC : AM1.5 1000W/m ² 25°C		NOCT : AM1.5 800W/m ² 20°C 1m/s		Test uncertainty for Pmax ±3%	
	LR8-66HVD-640M	LR8-66HVD-645M	LR8-66HVD-650M	LR8-66HVD-655M	LR8-66HVD-660M	LR8-66HVD-665M
Module Type	LR8-66HVD-640M	LR8-66HVD-645M	LR8-66HVD-650M	LR8-66HVD-655M	LR8-66HVD-660M	LR8-66HVD-665M
Testing Condition	STC	STC	STC	STC	STC	STC
Maximum Power (Pmax/W)	640	645	650	655	660	665
Open Circuit Voltage (Voc/V)	49.52	49.62	49.72	49.82	49.92	50.02
Short Circuit Current (Isc/A)	16.38	16.46	16.54	16.62	16.70	16.78
Voltage at Maximum Power (Vmp/V)	40.78	40.88	40.98	41.08	41.18	41.28
Current at Maximum Power (Imp/A)	15.69	15.78	15.86	15.94	16.03	16.11
Module Efficiency(%)	23.69	23.88	24.06	24.25	24.43	24.62



- **Sigenergy's SigenStor EC 3.0 TP**

Sigen Energy Controller 3.0-12.0 kW Single Phase ¹

SigenStor EC	3.0 SP	3.6 SP	4.0 SP	4.6 SP	5.0 SP	6.0 SP	8.0 SP	10.0 SP	12.0 SP	Units	
DC Input (from PV)											
Max. PV power	6000	7360	8000	9200	10000	12000	16000	20000	24000	W	
Max. DC input voltage						600					V
Nominal DC input voltage						350					V
Start-up voltage						100					V
MPPT voltage range						50 ~ 550					V
Number of MPP, trackers	2							3	4	4	
Number of PV strings per MPPT						1					
Max. input current per MPPT						16					A
Max. short-circuit current per MPPT						20					A
AC Output (on-grid)											
Nominal output power	3000	3680	4000	4600	5000	6000	8000	10000	12000	W	
Max. output apparent power	3300	3680	4400	5000	5500	6600	8800	11000	12000	VA	
Nominal output current	13.6	16.0	18.2	20.9	22.7	27.3	36.4	45.5	54.6	A	
Max. output current	15.0	16.0	20.0	22.7	25.0	30.0	40.0	50.0	54.6	A	
Nominal output voltage	220 / 230 / 240							220 / 230		V	
Nominal grid frequency						50 / 60					Hz
Power factor						0.8 leading ~ 0.8 lagging					
Total current harmonic distortion						THDi < 2%					
Efficiency											
Max. efficiency	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	97.6%	97.6%	97.6%		
European efficiency	97.0%	97.1%	97.2%	97.3%	97.4%	97.4%	97.0%	97.0%	97.0%		
AC Output (backup)											
Peak output power (10 seconds)	4500	5520	6000	6900	7500	9000	12000	15000	15000	W	
Nominal output voltage	220 / 230 / 240							220 / 230		V	
Nominal output frequency						50 / 60					Hz
Power factor						0.8 leading ~ 0.8 lagging					
Total voltage harmonic distortion						THDv < 2%					
Disruption time of backup switch ²						0					ms
Battery Connection											
Battery module models						SigenStor BAT series					
Number of modules per controller						1 ~ 6					pcs
Battery module voltage range						300 ~ 600					V
Protection											
Safety protection feature	DC reverse polarity protection, Insulation monitoring, Residual current monitoring, Arc fault circuit interrupter ³ , AC overcurrent/overvoltage/short-circuit protection. Type II DC/AC surge protection, Anti-islanding protection										
General Data											
Dimensions (W / H / D)	700 / 300 / 245							700 / 300 / 260		mm	
Weight	18							36		kg	
Storage temperature range						-40 ~ 70					°C
Operating temperature range						-30 ~ 60					°C
Relative humidity range						0% ~ 100%					
Max. operating altitude						4000					m
Cooling	Natural convection							Smart air cooling			
System ingress protection rating						IP66					
Communication	WLAN / Fast Ethernet / RS485 / Sigen CommMod (4G/3G/2G)										
Standard Compliance											
Standard ⁴	IEC/EN 62109-1, IEC/EN 62109-2, IEC/EN 61000-6-1, IEC/EN 61000-6-2										



- **Sigenergy's SigenStor EC 30 TP**

Sigen Energy Controller 5.0–30.0 kW Three Phase ¹

SigenStor EC	5.0 TP	6.0 TP	8.0 TP	10.0 TP	12.0 TP	15.0 TP	17.0 TP	20.0 TP	25.0 TP	30.0 TP	Units	
DC Input (from PV)												
Max. PV power	8000	9600	12800	16000	19200	24000	27200	32000	40000	48000	W	
Max. DC input voltage						1100						V
Nominal DC input voltage						600						V
Start-up voltage						180						V
MPPT voltage range						160 ~ 1000						V
Number of MPP. trackers	2			3			4					
Number of PV strings per MPPT						1						
Max. input current per MPPT						16						A
Max. short-circuit current per MPPT						20						A
AC Output (on-grid)												
Nominal output power	5000	6000	8000	10000	12000	15000	17000	20000	25000	30000	W	
Max. output apparent power	5500	6600	8800	11000	13200	16500	18700	22000	27500	33000	VA	
Nominal output current	7.6	9.1	12.2	15.2	18.2	22.8	25.8	30.4	38.0	45.5	A	
Max. output current	8.4	10.0	13.4	16.7	20.1	25.1	28.4	33.4	41.8	50.0	A	
Nominal output voltage						380 / 400, 3W+N+PE					V	
Nominal grid frequency						50 / 60					Hz	
Power factor						0.8 leading ~ 0.8 lagging						
Total current harmonic distortion						THDi < 2%						
Efficiency												
Max. efficiency	98.1%	98.2%	98.3%	98.3%	98.3%	98.3%	98.3%	98.3%	98.3%	98.4%		
European efficiency	96.1%	96.6%	97.1%	97.5%	97.7%	97.9%	97.9%	97.9%	98.0%	98.0%		
AC Output (backup)												
Peak output power (10 seconds)	7500	9000	12000	15000	18000	22500	25500	30000	30000	36000	W	
Nominal output voltage						380 / 400, 3W+N+PE					V	
Nominal output frequency						50 / 60					Hz	
Power factor						0.8 leading ~ 0.8 lagging						
Total voltage harmonic distortion						THDv < 2%						
Disruption time of backup switch ²						0					ms	
Battery Connection												
Battery module models						SigenStor BAT series						
Number of modules per controller						1 ~ 6					pcs	
Battery module voltage range						600 ~ 900					V	
Protection												
Safety protection feature	DC reverse polarity protection, Insulation monitoring, Residual current monitoring, Arc fault circuit interrupter ³ , AC overcurrent/overvoltage/short-circuit protection. Type II DC/AC surge protection, Anti-islanding protection											
General Data												
Dimensions (W / H / D)						700 / 300 / 260					mm	
Weight						36					kg	
Storage temperature range						-40 ~ 70					°C	
Operating temperature range						-30 ~ 60					°C	
Relative humidity range						0% ~ 100%						
Max. operating altitude						4000					m	
Cooling						Smart air cooling						
System ingress protection rating						IP66						
Communication						WLAN / Fast Ethernet / RS485 / Sigen CommMod (4G/3G/2G)						
Standard Compliance												
Standard ⁴	IEC/EN 62109-1, IEC/EN 62109-2, IEC/EN 61000-6-1, IEC/EN 61000-6-2											



- **SigenStor BAT LiFePO4-10**

Sigen Battery 6.0 / 10.0

SigenStor BAT	6.0	10.0	Units
Performance Specification			
Battery type	LiFePO4		
Cell capacity	314		
Cycle life ¹	10000		
Total energy capacity	6.02	9.04	kWh
Usable energy capacity ²	5.84	8.76	kWh
Depth of discharge ³	100%		
Max. charge / discharge power	3000	4600	W
Peak charge / discharge power (10 seconds)	4500	6900	W
General Data			
Weight	62	78	kg
Dimensions (W / H / D)	767 / 270 / 265		
Storage temperature range	-25 ~ 60		
Operating temperature range	-20 ~ 55		
Relative humidity range	5% ~ 95%		
Max. operating altitude	4000		
Cooling	Natural convection		
System ingress protection rating	IP66		
Installation method	Floor standing / Wall-mounted		
Number of modules per controller	1 ~ 6		
Compatible inverters	SigenStor EC series, Sigen Hybrid SP2/TP2 series ⁴		
Standard Compliance			
Standard ⁵	IEC/EN 60730-1, UN 38.3, IEC/EN 62619, IEC/EN 63056, IEC/EN 62477		
	SigenStor BC		
Operating voltage range (Single Phase)	300 ~ 600		
Operating voltage range (Three Phase)	600 ~ 900		
Weight	8		
Dimensions (W / H / D)	765 / 109 / 260 (without decorative cover)		
Compatible battery	SigenStor BAT series		
Compatible inverter	Sigen Hybrid SP2/TP2 series		
Communication	CAN		



1. This is provided by the battery cell manufacturer. Based on cell test condition of 25±2°C, 0.5C charge and discharge rate and SOH=60%.
2. Test conditions: 100% depth of discharge, 0.2C rate charge & discharge averagely at 25°C, at the beginning of life.
3. Refers to the usable energy capacity. Battery must be recharged within 7 days after being fully discharged to keep battery healthy.
4. SigenStor BC must be used if Sigen Hybrid SP2/TP2 is to be connected to the Sigen Battery.
5. For all standards refer to the certificates category on the Sigenenergy website.



- **Sigen Gateway C180-9 and C-1200**

Sigen Energy Gateway for SigenStor

Sigen Gateway	C60-2	C120-6	C180-9	C300-12	C600	C1200	Units
Grid Connection							
Grid connection type	Three phase						
Nominal AC voltage	380 ~ 400						V
Nominal AC current	91.2	182.4	274	456	912	1,824	A
Nominal AC power	60	120	180	300	600	1,200	kW
Nominal AC frequency	50 / 60						Hz
Disruption time of backup switch ¹	0						ms
AC Output to Backup Port							
Nominal AC voltage	380 ~ 400						V
Nominal AC current	91.2	182.4	274	456	912	1,824	A
Nominal AC power	60	120	180	300	600	1,200	kW
Nominal AC frequency	50 / 60						Hz
Overvoltage category	III						
Inverter Connection							
Number of connection ports	2	6	9	12	30	50	
Nominal AC voltage	380 ~ 400						V
Max. AC input current	45.6						A
Smart Port Connection							
Generator output voltage	380 ~ 400						V
Nominal AC current	91.2	182.4	274	456	912	1,824	A
Nominal AC power	60	120	180	300	600	1,200	kW
Generator 2-wire start	Supported						
General Data							
Dimensions (W / H / D)	510 / 795 / 173	850 / 1,152 / 305	800 / 2,300 / 830		1,800 / 2,300 / 1,270		mm
Weight	35	74	350	400	1,100	1,300	kg
Storage temperature range	-40 ~ 70						°C
Operating temperature range ²	-30 ~ 55						°C
Relative humidity range	0% ~ 100%		0% ~ 95%		0% ~ 95%		
Max. operation altitude ²	4,000						m
Cooling	Natural convection		Natural convection		Smart air cooling		
Ingress protection rating	IP54		IP20		IP20		
Communication	Fast Ethernet, RS485, dry contact						
Installation method	Wall-mounted		Ground-mounted		Ground-mounted		

1. This refers to the load-side disruption time, to achieve this functionality Sigen Energy Gateway needs to be used together with Sigen Energy Controller and Sigen Battery. Test conditions: In the open-circuit state of the power grid, the nominal power of the Sigen Energy Controller is higher than the total power of the backup loads.
2. Please consult Sigenenergy for detailed power derating information and customized requirements.

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