

Overview and Component Specifications



Cost Effective Storage Today

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WattGrid 10 Overview and Component Specifications

Electronics

WattGrid Overview and Component specifications

WattGrid ES series inverter (hybrid Inverter) is bidirectional, which applies to Grid connected PV systems with battery stored energy.

Energy produced by the PV system is used to optimize self-consumption; excess energy is used to charge the batteries, and then the batteries supplement the House load when the PV energy is inadequate.

When PV energy output is insufficient to support connected loads, the system automatically gets energy from the batteries if battery capacity is above 40% SOC. If the battery capacity is insufficient to meet consumption requirements, electricity will be drawn from the grid.

WattGrid ES Series Inverter has a UPS function (uninterrupted power supply), so in event of blackout the UPS will support designated backup circuits.



There are 4 basic work Modes to the system

Mode 1

Energy produced by the PV is preferred by the local loads and excess energy is used for charging the batteries.

Mode 2

If there is no PV, Batteries will supplement the house load along with the grid.

Mode 3

Grid Failure, When, blackout occurs the UPS function, automatically powers designated Backup circuits such as Lighting and Fridge circuits.

Mode 4

Time of use customers - Battery supplies energy only in peak hour times ensuring maximum ROI.

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WattGrid 4.6kW/10kWh Storage System - Energy Graphs, Domestic site Brisbane Queensland Winter



1.1 Graph shows a household daily load of 33.1kWh (kilowatt hours). = \$9.27 (based on \$0.28 per kWh)



The light blue area depicts PV power generated for the day





WattGrid 4.6kW/10kWh Storage System - Energy Graphs, Domestic site Brisbane QLD Winter continued



Shows battery being charged by solar 8am – 5pm as well as solar providing power for home.



1.2 Graph shows the battery storage system and Solar providing 20.4kWh of the daily load requirement. = \$5.71 per day (based on \$0.28 per kWh) = this equals a total \$2084 per amount.

Please note – these results are based on a winter season when summer is included we would expect significant increase in power generation production.

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Comparison of systems available

Features	WattGrid	Tesla (sold out till 2017)	Power Legato	LG	Samsung	
Retail Price	\$10,990	\$7,000-\$10,000 (battery pack and bms only - no inverter)	\$15,000	\$7999 (battery pack only, no bms or inverter)	\$8,999	
Capacity	10kWh	7kWh	7.2kWh	6.4kWh	3.6kWh	
Load Capacity	4.6kW continuous, 6.9kW peak	5kW continous, 7kW peak	3kW continuous, 4.5kW peak	unkown continuous, 5.0kW peak	3.24kW Continuous, unkown	
Phase	Single phase	No Australian Compliance	single phase only	Single phase only	single phase only	
Inverter	4.6kW Hybrid inverter	Not included	4.5kW Hybrid inverter	Not included	included	
UPS	UPS feature included	No UPS features	UPS feature available	No UPS features	unkown	
Warranty	5 years	10 year warranty	unkown	unkown	5 years / 10 year performance	
Round trip DC efficiency	93%	92%	Unkown 95%		95%	
Voltage	48v	350-400 volts	48 volts	51.8 volts	unknown	
Operating temperature	-20°C to 43°C	-20°C to 43°C	-20°C to 40°C	0°C to 40°C	-10°C to 40°C	
Expected Life	>8 years	unknown	unkown	>10 years	unkown	
Remote Monitoring	yes	Not available	yes	unknown	yes	
Web Portal	yes	Not available	yes	yes	yes	
Weight	775kg	100kg	140kg	60kg	95kg	
Dimensions	1450 x 450 x 1160	1300 x 860 x 180	672 x 688 x 180	406 x 664 x 165	1000 x 267 x 680	

As shown in the above comparison storage is currently selling for approx. \$1400 - \$2500 per kW The **WattGrid** product can do this for \$1000 per kW.

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NB It is recommended that total PV power should not exceed 130% of maximum DC power

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Technical Specifications

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Ivioaei	GW5048D-ES	GW3648D-ES					
Solar	5400						
* Max. DC power(W)	5400	4200					
Max. DC voltage (V)	580	580					
MPPT voltage range (V)	125~550	125~550					
Starting voltage (V)	125	125					
Max. DC current (A)	15/15	15/15					
DC overcurrent protection(A)	20	20					
No. of DC connectors	2	2					
No. of MPPTs	2(can parallel)	2(can parallel)					
DC overvoltage category		Category I					
DC connector		SUNCLIX / MC4					
Battery		(Optional)					
Battery Type	Lead-acid or Li-Ion	Lead-acid or Li-Ion					
Battery Rated voltage (V)	48	48					
MAX Discharge power (W)	4600	4600					
Charge current (A)	5-50 A continuous, programmable	5-50 A continuous, programmable					
Battery capacity (Ah)	>100-500AH(depending requirement)	>100-500AH(depending requirement)					
Charging curve	3-stage adaptive with maintenance	3-stage adaptive with maintenance					
Charging voltage	57V	57V					
Batterytemperature	included(Li-Ion)	included(Li-Ion)					
Battery voltage sense	integrated	integrated					
Current shunt	integrated	integrated					
AC Output Data							
Nominal AC power(W)	4600	3600					
Max. AC power(W)	4600	3600					
Peak power (Back-up)(W)	1.5x Pnom, 10sec	1.5x Pnom, 10sec					
Max. AC current(A)	20	16					
AC overcurrent protection(A)	30	24					
Nominal AC output	5	0/60Hz; 230Vac					
AC output range	45~55Hz/55~65Hz	; 180~270Vac					
AC output (Back-up)	230Vac ±2%, 50Hz ±0.2%,	THD v<3%(linear load)					
THD	<1 5%						
Power factor							
Grid connection		Single phase					
AC overvoltage category							
Efficiency							
Max. efficiency	97.6%	97.6%					
Euro efficiency	97.0%	97.0%					
MPPT adaptation efficiency		99.9%					
- adaptation enterency							



Safety Specifications

Model	GW5048D-ES	GW3648D-ES
Protection		
Residual current monitoring unit	Integra	ated
Anti-islanding protection	Integra	ated
DC switch(PV)	Integrated (optional)
AC over current protection	Integra	ated
Insulation monitoring	Integra	ated
Certifications & Standards		
Grid regulation	VDE4105, VDE 0126-1-1+A1, G83/	2, G59/2, AS4777.2/.3, IEC62109-2
Safety	IEC62109-1&-2, AS	3100, IEC62040-1
EMC	EN61000-6-1, EN61000-6-2, EN61000-6-3, 12	EN61000-6-4, EN61000-3-11, EN61000-3-
General Data		
Dimensions (WxHxD)	516*440*184mm	516*440*184mm
Weight (kg)	30	28
Mounting	Wall-m	ounted
Ambient temperature range	-25~60°C (>4	5°C derating)
Relative humidity	0~9	5%
Moisture location category	4K4	4H
Max. operating altitude	200	10m
Protection degree	IPt	65
Environment category	Outdoor	& indoor
External environment pollution	Grade1	、2、3
Topology	Transfor	mer-less
Standby losses(W)	<	8
Cooling	Natural co	onvection
Noise emission(dB)	<2	25
Display	LED light	t & APP
Communication	USB2.0 (or Wi-Fi
Standard warranty(years)	5/10/15/20/2	25 (optional)

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Battery Technology

Deep cycle gel batteries are a proven technology with over 50 years of testing and improvement. OPzV Gel batteries are regarded as the most robust and maintenance free, with proven cycle life in isolated regions.

Main Technical Advantages

* Plate: positive plate uses Pz tubular plate which can prevent active material falling, and adopts multi- component alloy frame, has fine corrosion resisting performance and long service life. * Negative plate uses special radiated structure.

* Separator: uses Amer-Sil, micro-pore PVC- separator from Europe, separator has large porosity and low resistance.

*Electrolyte: From Germany gas silicon dioxide, Sio2 electrolyte in gel state in the battery without flowing, leakage and lamination can be avoided.

* Safety valve: uses Germany technology, constant opening and closing, accumulator case expansion, so damage and electrolyte dry up can be avoided.

F.V/Time	10min	15min	30min	1h	2h	3h	5h	8h	10h
1.85V/cell	274	253	206	157	105	81.0	55.5	38.7	32.8
1.80V/cell	337	306	240	176	115	88.1	59.8	41.4	35.0
1.75V/cell	399	343	256	183	119	90.1	61.0	42.1	35.6
1.70V/cell	448	374	271	191	122	91.9	61.9	42.7	36.0
1.65V/cell	481	395	282	196	124	93.6	62.9	43.2	36.3
1.60V/cell	503	409	289	199	126	94.7	63.5	43.5	36.6

Constant Current Discharge (Amperes) at 20 0C (680F)

Constant Current Discharge (Amperes) at 20 0C (680F)

F.V/Time	10min	15min	30min	1h	2h	3h	5h	8h	10h
1.85V/cell	510	475	394	303	204	158	109	76.7	65.2
1.80V/cell	616	567	455	339	223	171	117	82.0	69.5
1.75V/cell	717	626	480	350	228	174	119	83.2	70.5
1.70V/cell	790	673	503	362	233	177	121	84.1	71.2
1.65V/cell	833	700	518	369	237	180	122	84.9	71.8
1.60V/cell	855	715	526	373	239	181	123	85.3	72.2

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Amer-Sil Separators Amer-Sil/Corugated

Thickness(mm)	2.0
Backweb(mm)	0.50
Porosity(cm3/g)	1.58
Pore volume(%)	78
Elec. Resistance (m@.cm²)	55
Acid displacement (ml/m2)	230
Oxidation weight loss(%)	3
Wettability(s)	1



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Sio2 Gel

Application of sulfuric acid immobilized on silica gel as an efficient and benign catalyst has been explored in the synthesis of 2,4,5-Triaryl-1H-imidazoles via condensation reaction of benzil or benzoin, aldehyde and ammonium acetate. The key advantages of this process are high yields, cost effectiveness of catalyst, easy work-up, purification of products by non-chromatographic method and the reusability of the H2SO4 SiO2 catalyst.

Trisubstituted Imidazoles; Solvent-Free Synthesis; Multicomponent Reaction; Silica-Supported Sulfuric Acid; Heterogeneous Catalyst

Introduction

Multicomponent reactions (MCRs) have drawn great interest enjoying an outstanding status in modern organic synthesis and medicinal chemistry because they are one- pot processes bringing together three or more components and show high atom economy and high selectivity [1,2]. MCRs have great contribution in convergent synthesis of complex and important organic molecules from simple and readily available starting materials, and have emerged as powerful tools for drug discovery [3,4]. The imidazole nucleus is a fertile source of biologically important molecules.

Compounds containing imidazole moiety have many pharmacological properties and play important roles in biochemical processes. They are well known as inhibitors of P38MAP kinase, fungicides, herbicides, anti- inflammatory agents, antithrombotic agents, plant growth regulators and therapeutic agents. In addition, they are used in photography as photosensitive compounds. Some substituted triarylimidazoles are selective antagonists of the glucagons receptor and inhibitors of IL-1 biosynthesis [5]. Radziszewski and Jaap proposed the first synthesis of the imidazole core in 1882, starting from

1,2-di- carbonyl compounds, aldehydes and ammonia to obtain 2,4,5-triphenylimidazole [6,7]. There are several methods for the synthesis of 2,4,5-triarylimidazoles using H3PO4·12MoO3·24H2O, KH2PO4 [8], catalyst-free under microwave irradiation [9,10], ionic liquid (1-n-butyl and 1,3-di-butyl imidazolium salts) [11], ceric (IV) ammo- nium nitrate (CAN) [12], oxalic acid [13], Eu(OTf)3 [14],

[Hmim]HSO4 [15], ZrCl4 [16], Yb(OTf)3 [17], NiCl2 ·6H2O

[18], sodium bisulfate [19], iodine [20], nanocrystalline magnesium Oxide [21], oxalic acid [22], silica

sulfuric acid [23], acetic acid [24], L-proline [25], PEG-400 [26],

Cu(TFA)2 [27], tetrabutylammoniumbromide (TBAB) [28],

(NH4)6M07O24·4H2O [29], InCl3·6H2O [30], Zr(acac)4

[31], anhydrous FePO4 [32] and uranyl nitrate hexahydrate [UO2(NO3)2.6H2O] supported on acidic alumina [33].

Many of these methods, however, suffer from longer reaction times, unsatisfactory yields, difficult workup, and excessive use of reagents and catalyst. It is therefore important to find more convenient methods for the preparation of these compounds. Therefore, the, development of a new mild method to overcome these disadvantages still remains a challenge for organic chemists. One of the aims we have in mind is to introduce a new catalyst for synthesis of 2,4,5-trisubstituted imidazoles with cost effectiveness and mild condition in high yields.

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Several methods are used in the synthesis of these trisubstituted imidazoles and their derivatives. In addition, the synthesis of these heterocycles has been usually carried out in polar organic solvents such as ethanol, methanol, acetic acid, DMF and DMSO leading to complex isolation and recovery procedures. These processes also generate waste containing catalyst and solvent, which have to be recovered, treated and disposed of. The toxicity and volatile nature of many organic solvents, particularly chlorinated hydrocarbons that are widely used in huge amounts for organic reactions have posed a serious threat to the environment [34]. Thus, design of solvent-free catalytic reaction has received tremendous attention in recent times in the area of green synthesis [35].

Solid acids and especially those based on micelle- template silica's and other mesoporous high surface area support materials are beginning to play a significant role in the greening of fine and specialty chemicals manufacturing processes. A wide range of important organic reactions can be efficiently catalyzed by these materials, which can be designed to provide different types of acidity as well as high degrees of reaction selectivity. The solid acids generally have high turnover numbers and can be easily separated from the organic components [36,37].

In recent years the H2SO4 immobilized on SiO2 was used as a catalyst for synthesis of organic compounds [38-42]. In this work, we report the solvent-free synthesis of 2,4,5-trisubstituted imidazoles using H2SO4 immobilized on SiO2 as a catalyst under classical heating. Efficiency of this reaction is mainly affected by the amount of catalyst, temperature and reaction time.

For getting the best conditions, initially we started the condensation of benzil (1 mmol), 4-chloro benzaldehyde (1 mmol) and ammonium acetate (5 mmol) in the presence of H2SO4 immobilized on SiO2 (0.005 gr) as a catalyst at 100°C for 1 h, which led to low yield (40%) of 2,4, 5-trisubstituted imidazole. To enhance the yield of the desired product the temperature of the reaction was increased to 120°C. With increasing the temperature, the productivity of the reaction increased but was not very high. Then, it was thought worthwhile to carry out the reaction in the presence of higher amount of the catalyst, Maximum yield was obtained (94%) when the reaction was loaded with 0.01 gr of the catalyst at the 110°C. A further increasing of catalyst loading does not affect the yield.

After optimizing the conditions, we applied this catalyst for synthesis of trisubstituted imidazoles by using different aromatic aldehydes with a wide range of ortho, meta- and para-substitutions under solvent-free classical heating conditions to establish the catalytic importance of H2SO4 immobilized on SiO2 for this reaction.Generally, the synthetic procedure involves stirring the mixture of aldehyde (1 mmol), benzil (1 mmol), ammonium acetate (5 mmol) and H2SO4 immobilized on SiO2 (0.01 gr) for 45 - 60 min at 110°C. The corresponding results are given in Table 2. We found that the reaction proceeded very efficiently either electron-releasing or electron-withdrawing substituents on aryl ring of aldehyde.

Also, due to direct use of benzoin rather than benzil in the synthesis of imidazoles a significant improvement in the synthesis toward the greener chemistry is represented. We have repeated the reaction with benzoin instead of benzil and the desired product has been efficiently produced, when we used benzoin instead of benzil, the reaction time increased and also the yield of the reaction decreased partially.

Possible mechanism for the sulfuric acid immobilized on silica gel catalysed synthesis of trisubstituted imidazoles has been proposed.

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