

World Leading Manufacturer of **Supercapacitors** and **Fuel Cell Materials**

VISION FOR NATURE



VINATech History

2020

- To be listed on KOSDAQ
- Grand Prize of the 7th KONEX Awards
- Winner of National Industry Awards of R&D

A leading energy storage system producer

2018

- VINATech R&D Center completed in HQ
- Vietnam Factory completed
- New Sales Office in Anyang
- High technology enterprise
- Industrial Technology of the Month



2012

- Selected as Global Small & Strong Business
- Grand Prize Small Business IP Manager
- Certified for New Technology(NET)
- Selected as Global IP Star Corporation



2010

- Developed 3V-level super-capacitor
- Certified for Best HRD
- Certified for INNO-BIZ 2006
- Selected as a promising Small and Medium Enterprises

2002

- Developed Fuel Cell Material
- Carbon support, Catalyst, MEA(PEMFC/DMFC)



2019

- Leading SME Award by Korean Government
- Export-Tower Award by Korea International Trade Association
- Top 100 Companies to work' Selected in Korea



2014

- Korean Intellectual Property Office Award in R&D
- Certified for high-end technology products
 - KONEX Market IPO
- Certified as a parts & materials producer

An energy storage system specialist

2011

- Advanced Technology Center (ATC)
- Relocate Headquarters (Gunpo → Jeonju)



R&D for technical innovation

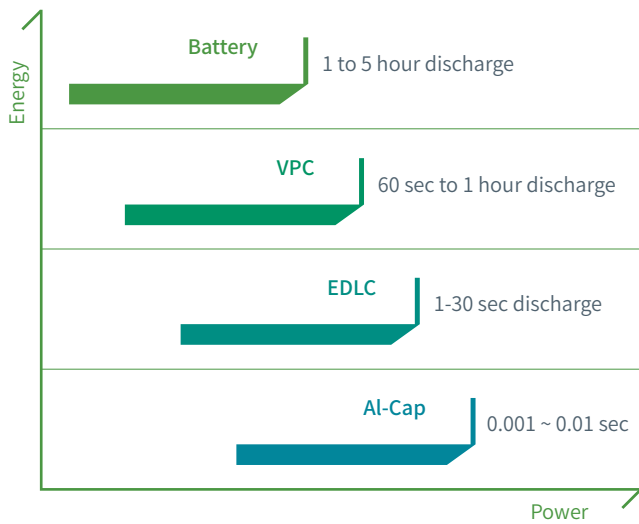
2005

- Best Venture
- Certified for ISO
- Began to mass-produce super capacitors



Hy+cap Introduction

Environment-friendly New Energy Storage Device

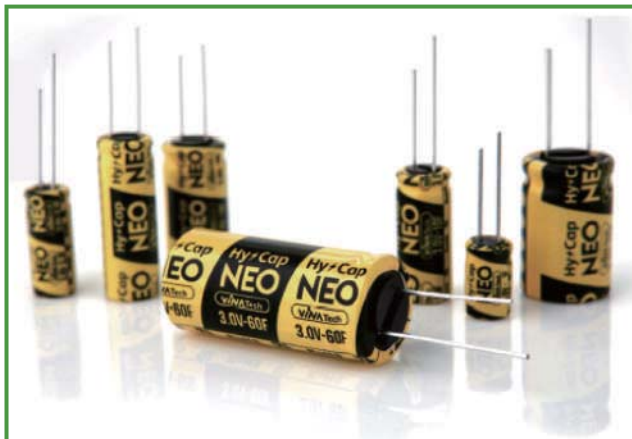


EDLC Capacitors(Electric Double Layer Capacitors also known as Super Capacitors or Ultra Capacitors), are environmentally friendly energy storage devices with low energy density and high power density when compared to Battery technology.

The advantages of EDLCs are high current, fast charge and discharge, long cycle life (500,000+cycles) and long lifetime with wide temperature ranges (-40°C~+85°C) RoHS, REACH & WEEE compliant safe for transportation.

VPC ranges are the new high density environmentally friendly Hybrid Lithium Capacitors offering high energy, low ESR and ultra low Leakage Current in small packages.

Features



EDLC | Electric Double Layer Capacitor

Rated Voltage 2.7V 3.0V

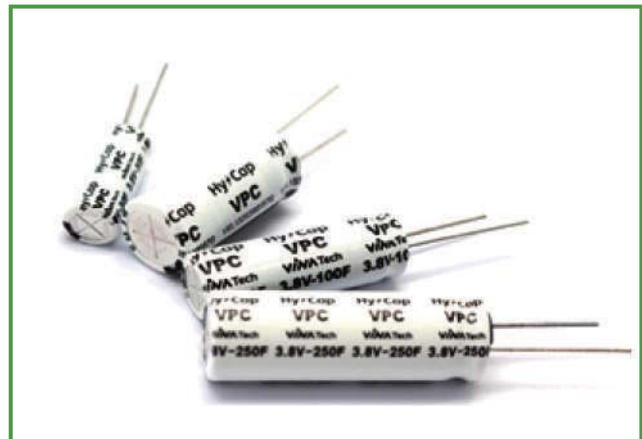
High Power Density(low ESR)

Over 500,000*cycle life

Short-term Peak Power Assist Applications

Operating temp. - 40°C ~ +65°C
(+85°C when de-rated)

(*½ cycle)



VPC | Vina Pulse Capacitor

Operating Voltage Range 2.5V to 3.8V

Higher Energy Small Size

50,000* cycle life

Ultra Low Self Discharge

Operating temp. - 25°C ~ + 85°C
(-40°C ~ +85°C in Li/SOCL2 battery system)

Market Leaders Choice

VINATech Product Applications area



AUTOMOTIVE & AFTER-MARKET

- Navigation and Dash Camera:
- Memory Back Up
- Car audio woofers:
- Compensate peak power
- Vehicle tracking and security
- Fail Safe applications, E-Call & E-Latch
- Fuel Cell generator



SENSOR NETWORKS, COMMUNICATIONS

- Long Term Back Up
- Pulse management
- 3.8V Lithium Capacitors



UNINTERRUPTIBLE POWER SUPPLY(UPS) DYNAMIC VOLTAGE RESTORER(DVR)

- Responds to momentary blackouts
- Compensate peak power
- Fuel Cells, Engine cranking

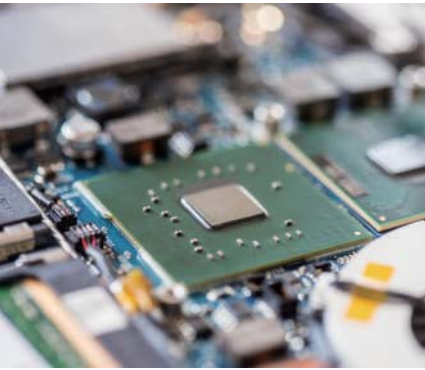


SMART METERS/NETWORK EQUIPMENT

- Long life: No maintenance
- Wider operating temperature : -40°C to +85 °C

Market Leaders Choice

VINATech Product Applications area



MEMORY BACK UP

- RAID,SSD, NVDIMM, DRAM to NAND Flash, Cache protection power backup
- Applied spec.: 3.0V (1F~100F)
- Circuit configuration based on cache density and power requirements.



REGENERATIVE ENERGY STORAGE DEVICE

- Hybrid electric cars, suitable for elevators or railway vehicles
- Reduce energy cost and CO2 emission
- Fuel Cells



WIND TURBINE

Pitch control:

- Compensate peak power
- Semi permanent and no maintenance



OTHER APPLICATION

- Medical & Dental equipment
- Actuators and Locking systems
- Building controls, Drones and Toys
- Robotics AGV Fault Indicators

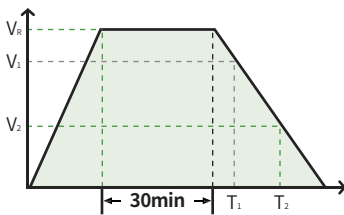
Hy₂cap Characteristics

Product Series	EDLC(VEC/WEC)	EDLC(VET)	VPC(VEL)
Voltage Range	Rated Voltage 2.7V _R / 3.0V _R	Rated Voltage 2.7V _R	Operating Voltage Range 2.5V to 3.8V
Operating Temp.	-40°C ~ +65°C (+85°C when de-rated)	-40°C ~ +85°C	-25°C ~ +85°C (-40 ~ 85°C in Li/SOCL2 battery system)
High Temp. Load life	1000 hours / V _R loaded under 65°C	1000 hours / V _R loaded under 85°C	1000 hours / 3.8V loaded under 70°C
Capacitance	≤ 30% of initial value		≤ 30% of initial value
ESR	≤ 2 times of specified value	≤ 3 times of specified value	≤ 2 times of specified value
85°C	De-rated voltage Max 2.3V / 2.4V	@ 2.7V	@ 3.5V
Cycle	500,000*		50,000
Shelf life	shelf life storage : 2 years from manufacturing date No electrical charge, Temp. below 70°C (ΔC: ≤10% of initial value/ΔESR: ≤50% of specified value)		Temp. : Below 70°C, No Electrical Charge Test time : 2 years Recommend every 6 month to charge V _R (ΔC: ≤10% of initial value /ΔESR: ≤100% of specified value)

(*½ cycle)

Measurement of Capacitance & ESR

Capacitance (F)



$C(F) = I \times \frac{(T_2 - T_1)}{(V_1 - V_2)}$	V_R	Rated Voltage
	V₂	0.8V _R
	V₁	0.4V _R
	I	Discharge Current (1mA per Farad)

DC ESR(Rd) is calculated by voltage drop (ΔV) which is measured by the period of time from discharge start to 10 milliseconds later.

Equivalent Series Resistance (ESR)

AC ESR is measured by 4-probe impedance analyzer. *Condition : Potentiostat mode, AC amplitude : 5mV, Frequency : 1kHz

VPC Measurement of Capacitance

C : Discharge capacitance (F)

I : Discharge Current (A)

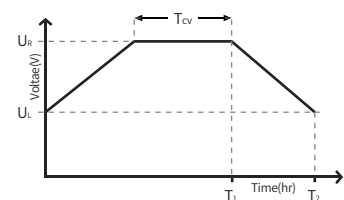
T₁ :time (s) from discharge start to reach U_R

T₂ :time (s) from discharge start to reach U_L

T_{cy}: Constant Voltage charging time: 30min)

U_L : Rated lower limit voltage (V), U_{2,at equation}

U_R : Rated voltage (V), U_{1 at equation}



*Module specification for 2 series cells has identical characteristics to above items.

*All test data in this catalogue follow IEC guidelines and VINATech use 25c for all tests unless otherwise stated.

*Visit our Web site for our new Capacitor Calculator.

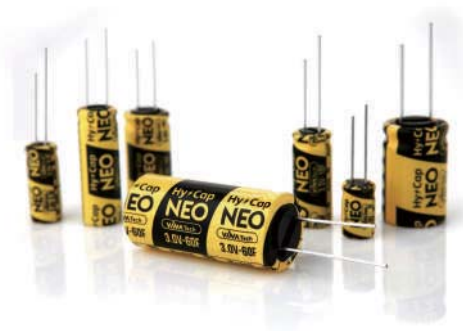
*Please contact us hycap@vina.co.kr if you need detailed datasheets and customization.

HyCap / Single Cell / Lead Terminal Type

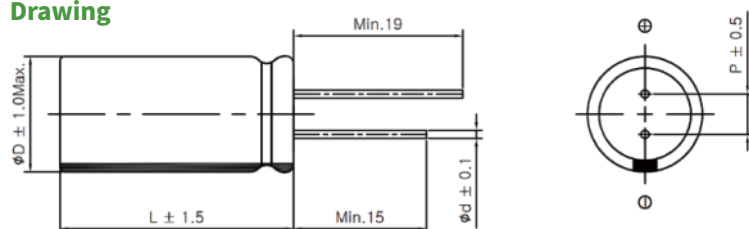
VINATech development engineers have developed the EDLC technologies in both 2.7V and 3.0V radial series to overcome the increasing challenges facing customers when finished products are installed in extreme conditions in areas of high temperature and high humidity. The challenging conditions are over and above recommended specifications for standard EDLCs.

Features

- High Power Density
- Over 500,000 cycle life (semi-permanent)
- RoHS/WEEE/REACH compliant
- Long-term reliability improved for extreme condition
- Short term peak power assist application



Drawing



D(∅)	8	10	13	16	18
d(∅)	0.6			0.8	
P(mm)	3.5	5.0		7.5	

Part Number	Rated Voltage	Capacitance (F)	ESR (mΩ)		Max. Current (A)	Leakage Current (mA, 72hr)		Size (mm)	Weight (g)	Volume (ml)
	(V _r)		AC(1kHz)	DC		(@2.7V)	(@3.0V)	D × L		
WEC3R0105QG	3.0	1	145	215	1.2	0.002	0.003	08 x 13	1.1	0.7
WEC3R0155QG		1.5	115	175	1.5	0.003	0.005	08 x 20	1.4	1.0
WEC3R0335QG		3.3	75	125	3.5	0.007	0.010	08 x 20	1.5	1.0
WEC3R0505QD		5	50	85	5.0	0.010	0.015	08 x 25	1.8	1.3
WEC3R0505QG		5	80	120	4.5	0.010	0.015	10 x 20	2.1	1.6
WEC3R0705QD		7	45	75	6.5	0.014	0.021	08 x 30	2.2	1.5
WEC3R0705QG		7	80	135	5.0	0.014	0.021	10 x 20	2.2	1.6
WEC3R0106QA		10	45	75	8.5	0.020	0.030	10 x 25	2.6	2.0
WEC3R0106QG		10	30	45	10.0	0.020	0.030	10 x 30	3.2	2.4
WEC3R0106QD		10	50	75	8.5	0.020	0.030	13 x 20	3.4	2.7
WEC3R0156QG		15	37	55	12.0	0.030	0.045	13 x 25	4.5	3.3
WEC3R0186QC		18	30	50	14.0	0.036	0.054	13 x 25	4.8	3.3
WEC3R0256QG		25	20	30	21.0	0.050	0.075	16 x 25	7.2	5.0
WEC3R0506QG		50	13	20	37.0	0.100	0.150	18 x 40	12.5	10.2
WEC3R0606QG		60	13	20	40.0	0.120	0.180	18 x 40	13.5	10.2
WEC3R0107QD		100	12	20	50.0	0.200	0.300	18 x 59	17.5	15.0

* Max. Current : 1 sec. discharge to 1/2V_r

* Connecting a module more than 2 series, please fully discharge over 1 hour first, then assemble right after within 1 hour

* N.B. VEC lead terminal series is not for New Designs

* Taping versions available for volume orders 8mm, 10mm & 13mm diameter products Also pre bending available

* For 2.7V and 5.4V VEC EDLC, not recommended for new design

HyCap / Module in 2 series

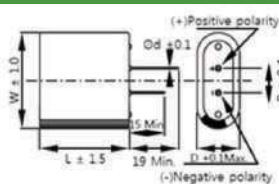
Features

- High Power Density
- Over 500,000 cycle life(Semi-permanent)
- 2 units serially connected to provide products
- RoHS/WEEE/REACH compliant
- Long term reliability improved for extreme condition



Drawing

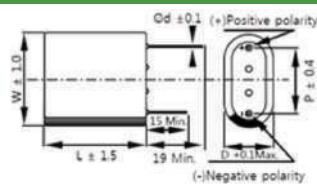
I TYPE



D = 8.5mm, d=0.6mm

Type	I	O	H
P	4.5	12.9	8.5

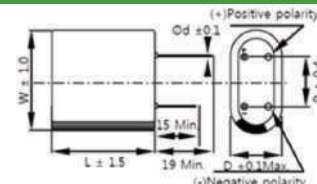
O TYPE



D = 10.5mm, d=0.6mm

Type	I	O	H
P	5.0	16.0	10.5

H TYPE



D = 16.5mm, d=0.8mm

Type	I	O	H
P	8.5	24.5	16.5

Item	Characteristics	
Product series	EDLC 2 Serial Module	
Rated Voltage (V _R)	6.0V	
Operating Temperature	-40 ~ +65°C(85°C when de-rated)	
Capacitance Tolerance	-10% ~ +30%	
High Temp. Load Life	After 1,000 hours at V _R loaded under +65°C, capacitors meet the following criteria.	
	Capacitance Change	≤ 30% of initial value
	ESR	≤ 2 times of specified value
Cycle Life Characteristics	Cycle	Over 500,000
	ΔC	≤ 30% of initial value
	ESR	≤ 2 times of specified value
	Method	Cycle of Charge/discharge from V _R to 1/2V _R
Shelf life	2 Years No Electrical Charge, Temperature below 70°C (ΔC : ≤ 10% of initial value / ΔESR : ≤ 50% of specified value)	

Part Number	Rated Voltage (V _R)	Capacitance (F)	ESR (mΩ)		Max. Current (A)	Leakage Current (mA, 72hr)		Size (mm) D x W x L	Weight (g)	Volume (ml)
			AC(1kHz)	DC		(@5.4V)	(@6.0V)			
WEC6R0504QG	6.0	0.5	295	435	1.2	0.002	0.003	8.5 x 17 x 15.5	2.5	2.2
WEC6R0155QG		1.5	155	255	3.5	0.007	0.010	8.5 x 17 x 22	3.3	2.8
WEC6R0255QG		2.5	165	245	4.5	0.010	0.015	10.5 x 21 x 22.5	4.7	4.4
WEC6R0355QG		3.3	165	275	5.5	0.014	0.021	10.5 x 21 x 22.5	4.7	4.4
WEC6R0505QA		5.0	95	155	8.5	0.020	0.030	10.5 x 21 x 27	6.6	6.3
WEC6R0505QG		5.0	65	95	10.0	0.020	0.030	10.5 x 21 x 32	6.6	7.1
WEC6R0755QG		7.5	79	115	12.0	0.030	0.045	13 x 26 x 28	9.6	9.5
WEC6R0126QG		12.5	45	65	21.0	0.050	0.075	16.5 x 32.5 x 28	17.2	17.7

* Max Current: 1sec. discharge to 1/2V_R

* When connecting more than 2 series, please fully discharge over 1 hour first, then assemble right after within 1 hour

* For 5.4V or VEC series, please contact the sales office, or VEC and 5.4V is not recommended for new design

* For 3 Series (9V) modules, contact the sales office

Hy+cap Single Cell / Snap-In Type

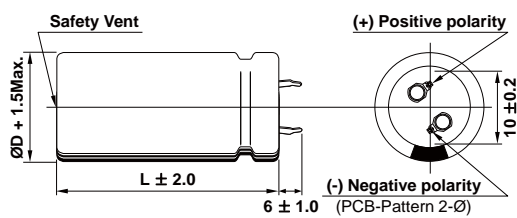
Features

- High Power Density Low ESR
- Over 500,000 cycle life(Semi-permanent)
- RoHS/WEEE/REACH compliant

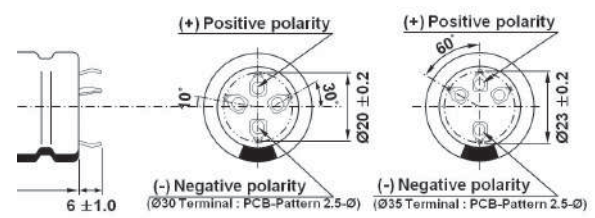


Drawing

2 PIN TYPE



4 PIN TYPE



3.0V VEC Series

Part Number	Rated Voltage	Capacitance (F)	ESR (m Ω)		Max. Current (A)	Leakage Current (mA, 72hr)	Size (mm)	Weight (g)	Volume (ml)
	(V _R)		AC(1kHz)	DC			D × L		
VEC3R0107QG	3.0	100	6.0	9.0	78	0.300	22 x 45	20.0	17.1
VEC3R0227QG		220	5.0	7.5	125	0.660	25 x 70	38.0	34.3
VEC3R0367QG		360	3.0	3.2	250	1.080	35 x 62	70.0	59.6
VEC3R0387QG		380	3.0	3.2	257	1.140	35 x 62	70.0	59.6
VEC3R0407QG		400	3.0	3.2	263	1.200	35 x 72	80.0	69.2
VEC3R0507QG		500	3.0	3.2	288	1.500	35 x 82	96.0	78.9

* Max. Current : 1 sec. discharge to 1/2V_R

* VEC 2.7V Snap-in type is not recommended for new design

Hy+cap / VET to Combat Extreme Conditions

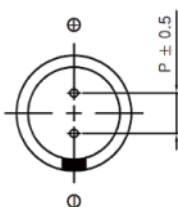
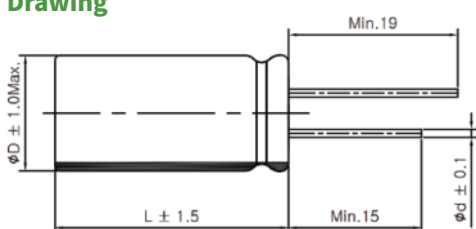
The limitation to higher temperatures has in the past been the Electrolyte used by Supercapacitor Manufacturers but now the R&D Team at VINATech have developed a new supercapacitor solution of NEO VET Series which will be particularly ideal for all IoT and AMI applications.

Features

- VET series of + 85°C Single cell 2.7V Supercapacitors
- Over 500,000 cycle life (semi-permanent)
- RoHS compliant
- High Power Density
- Short-term Peak Power assist applications
- Long-term reliability improved at high temperature 85°C and humidity of 85% RH



Drawing



D(Φ)	8	10	13		
L (mm)	20	20	30	40	25
d(Φ)	0.7				
P(mm)	3.5	5.0			

Item	Characteristics	
Rated Voltage (V _R)	2.7V	
Operating Temperature	-40 ~ +85°C	
Capacitance Tolerance	-10 ~ +30%	
High Temp. High Humidity Load Life	After 1,000 hours at V _R loaded under +85°C, 85% RH Humidity , capacitors meet the following criteria.	
	Capacitance Change	≤ 30% of initial value
	ESR	≤ 3 times of specified value
Cycle Life Characteristics	Cycle	Over 500,000
	ΔC	≤ 30% of initial value
	ESR	≤ 3 times of specified value
	Method	Cycle of Charge/discharge from V _R to 1/2V _R
Shelf life	2 Years No Electrical Charge, Temperature below 70°C (ΔC : ≤ 10% of initial value / ΔESR : ≤ 50% of specified value)	

* Max. Current : 1 sec. discharge to 1/2V_R

* Note: The products are tested based on the test conditions and methods defined in AEC-Q200

Part Number	Rated Voltage (V _R)	Rated Capacitance (F)	ESRAC (mΩ)	ESRDC (mΩ)	Max Current (A)	Leakage Current(mA)	Size (mm)	Weight (g)
	Surge Voltage (3.0V)	@ 25°C	@ 25°C 1kHz	@ 25°C 10msec	@ 25°C	@ 25°C	D × L	
VET2R7335QG	2.7	3.3	140	210	2.5	0.010	08 x 20	1.5±0.2
VET2R7505QG	2.7	5	90	135	4	0.015	10 x 20	2.2±0.2
VET2R7106QG	2.7	10	50	75	7.5	0.030	10 x 30	3.2±0.2
VET2R7156QD	2.7	15	40	60	10.5	0.040	10 x 40	4.3±0.2
VET2R7156QG	2.7	15	40	60	10.5	0.040	13 x 25	4.5±0.2

*Regarding purchasing modules, please contact hycap@vina.co.kr.

Hy+cap / VPC Vina Pulse Capacitor

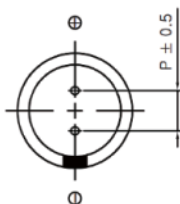
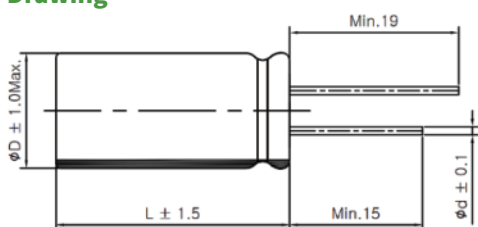
The new powerful VPC series offers high density, ultra low Leakage Current, low ESR and high energy from a new miniaturised Lithium Hybrid Capacitor development. VINATech have responded to market requests with 30F capacitance in 08 x 20 can, 100F, 150F and 250F family products. Ideally suited to supporting Battery powered products and IoT applications.



Features

- Ultra Low Self Discharge
- High Operating Voltage
- High Energy
- High Capacitance
- Wide Operating Temperature Range

Drawing



D(Φ)	8	10	13	13
L (mm)	20	30	25	35
d(Φ)	0.8			
P(mm)	3.5	5.0		

Item	Spec. value	Test methods
Operating Voltage Range	2.5V to 3.8V (2.5V to 3.5V @ 85°C)	
Operating Temp. Range	-25 ~ 85°C (-40°C ~ 85°C @ in Li/SOCL2 battery system)	
Load Life @ 70°C	Capacitance : ≤ 30% of initial value ESR : ≤ 2 times of specified value Appearance : No abnormality	- Temperature: 70±2°C, 85±2°C - Time : 1,000 hours - Voltage : 3.8V, 3.5V and measure the floating charge characteristics after returning to normal temperature and humidity.
Load Life @ 85°C		
Heat cycle characteristics		- Temperature: 85±2°C, -40±2°C - Duration: 30 min - Cycle Numbers: 100 cycles
Cycle Life		- Temperature : 25±2°C - Cycle Number : 50,000 - Discharge Current : 20 C-rate - Cut-off Voltage : 2.5V (DOD 100%)
Low Temperature characteristics	Capacitance : ≤ 50% of initial value ESR : Less than 20 times of specified spec.	The specification shall be met lower category temperature range of -25°C

#1 Reference IEC62813 4.2 | #2 1sec. Discharge to 3.2V

Part Number	Rated Voltage (V _R)	Rated Capacitance (F)	ESRAC (mΩ)	ESRDC (mΩ)	Leakage Current (μA)	Self Discharge (V)	Rated Current (A)	Pulse Current (A)	Weight (g)	Energy Density (Wh/kg)	Capacity (Ah/kg)
	Surge Voltage (4.0V)	@ 25°C #1	@ 25°C 1kHz	@ 25°C 10msec	@ 25°C 72hr	@ 25°C #1	@ 25°C	@ 25°C #2			
VEL08203R8306G	3.8	30	700	350	1	-3%	0.15	0.5	1.9±0.2	17.961	5.702
VEL10303R8107G	3.8	100	200	100	2	-3%	0.4	2.0	4.2±0.2	27.083	8.598
VEL13253R8157G	3.8	150	140	70	3	-3%	0.5	3.0	6.2±0.2	27.520	8.737
VEL13353R8257G	3.8	250	100	50	5	-3%	0.75	5.0	8.2±0.2	34.680	11.009

* Energy Density (Wh): $[0.5 \times C \times \{(V_{rated}^2) - (V_{min}^2)\}] / 3600$

* Capacity (Ah): $(C \times (V_{rated} - V_{min})) / 3600$

Hy+cap User Guidance

01 Do not take the product apart or damage at random. Follow guidelines for product placement (Soldering, pin formation etc.)
Warranty will not be granted if there has been failure to follow our guidelines.

02 Polarity

› This is a polarised product (+positive and -negative poles) so it must be used accordingly. The negative pole is clearly marked on the product sleeve.

03 Overvoltage and overcurrent

› It is recommended that the product should be used below the rated voltage. When used over the rated voltage, it could lead to vent expansion and failure, the useful life span will be shortened

› In case of connecting more than 2 units for modules, we recommend lowering the operating voltage per cell by a minimum of 10% from the rated voltage to ensure safer voltage balancing (e.g. 2.43V per unit in case of 2.7V series).

› It is recommended that the product should be applied below the maximum current. When used above the maximum current, it will lead to can expansion and failure or its life span will be shortened.

04 Working conditions and storage

› The working life of this product will be shortened by the working environmental conditions, such as temperature, humidity and air pressure among others.

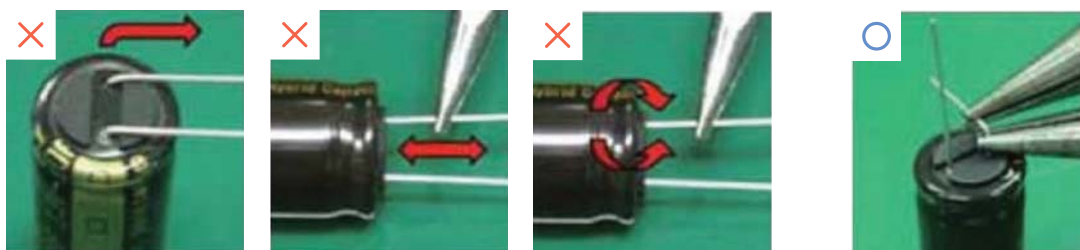
› Do keep the product within environmental conditions that are recommended in this document. Check with the sales office.

› Do not expose the product to over 75% relative humidity. When exposed for a long time, its life can be shortened or it can cause malfunction.

› Do not use or keep the product in the temperature range that is higher than recommended in this document. Its life will be shortened or it can cause malfunction.

› Do not use or keep the product in highly corrosive atmospheres that is composed of substances (for example, the environment that is exposed to halogen substances, such as Cl, F, or halogen compounds, nitrogen substances or nitrogen compounds, sulphur substances or sulphur compounds, hexavalent chrome, arsenic, among others).

EDLC Lead Terminal Bending Process



VPC Handling Guide



* Product head and fire may occur due to incorrect product storage, product measurement and processing.

Hy+cap / Module Customized Series

Features

- Ultra-low internal resistance
- High-power and reliable performance
- Over 500,000 duty cycles
- Compact & fully enclosed splash proof design

Applications

- Automotive
- AGV/ Robotics
- Consumer electronics
- Renewable energy system
- Short term UPS & Telecommunications
- Wind turbine pitch control



Part Number	Voltage (V)	Capacitance (F)	Cell Structure	Size(mm) (W x L x H)	Application
VEM 30R0 406 QG	30.0	40.0	3.0V – 400F 10S	180 x 180 x 70	Power Supply Control Unit
VEM 30R0 366 QG	30.0	36.0	3.0V – 360F 10S	122 x 150 x 70	
VEM 30R0 106 QG	30.0	10.0	3.0V – 100F 10S	160 x 60 x 50	
VEM 60R0 505 QG	60.0	5.0	3.0V – 100F 20S	146 x 104 x 70	
VEM 16R0 606 QG	16.0	60.0	3.0V – 360F 6S	37 x 233 x 70	Wind Turbine
VEM 60R0 415 QG	60.0	4.16	2.7V – 100F 24S	94 x 148 x 50	Electric Bicycle
VEM 27R0 255 QG	27.0	2.5	2.7V – 25F 10S	55 x 120 x 30	Electric Bicycle
VEM 144R0 755 QG	144.0	7.5	3.0V – 360F 48S	315 x 340 x 70	Regenerative Braking
VEM 18R0 127 QG	18.0	120	3.0V – 360F 6S2P	270 x 100 x 70	Power Back up
VEM 15R0 806 QG	15.0	80.0	3.0V – 400F 5S	126 x 82 x 70	
VEM 90R0 166 QG	90.0	16.6	3.0V – 500F 30S	400 x 200 x 90	

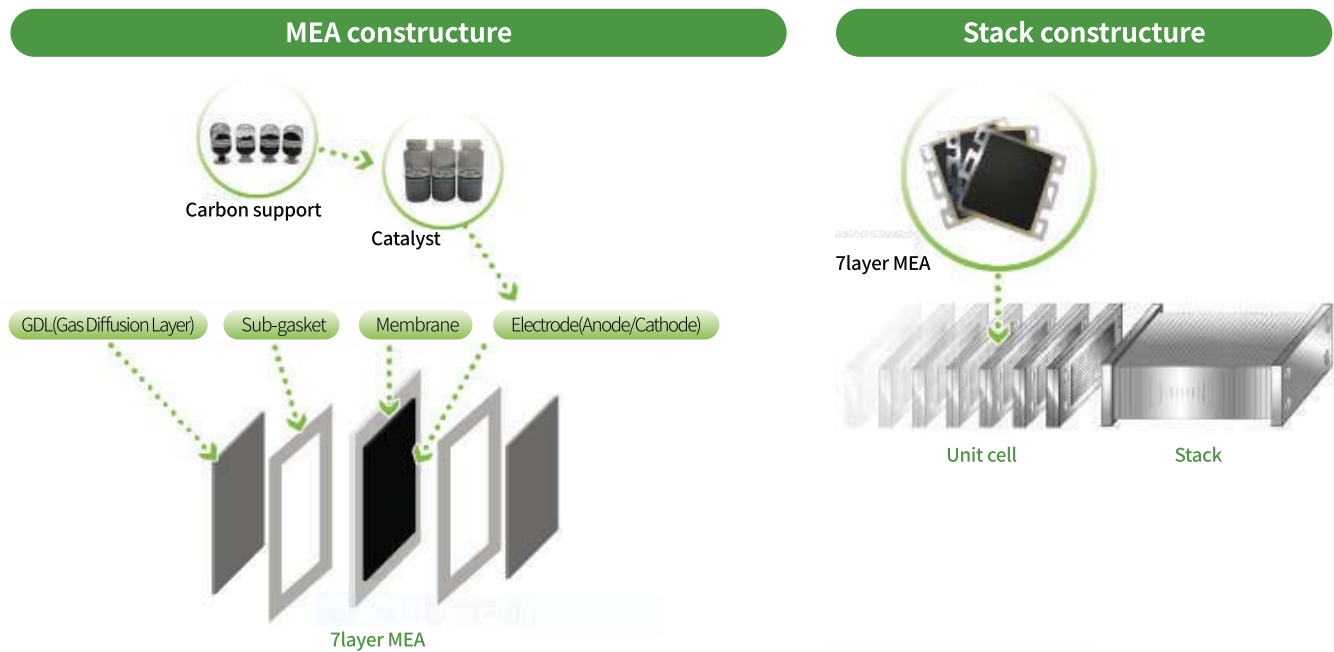
VINATech Fuel Cell Material

Membrane Electrode Assembly

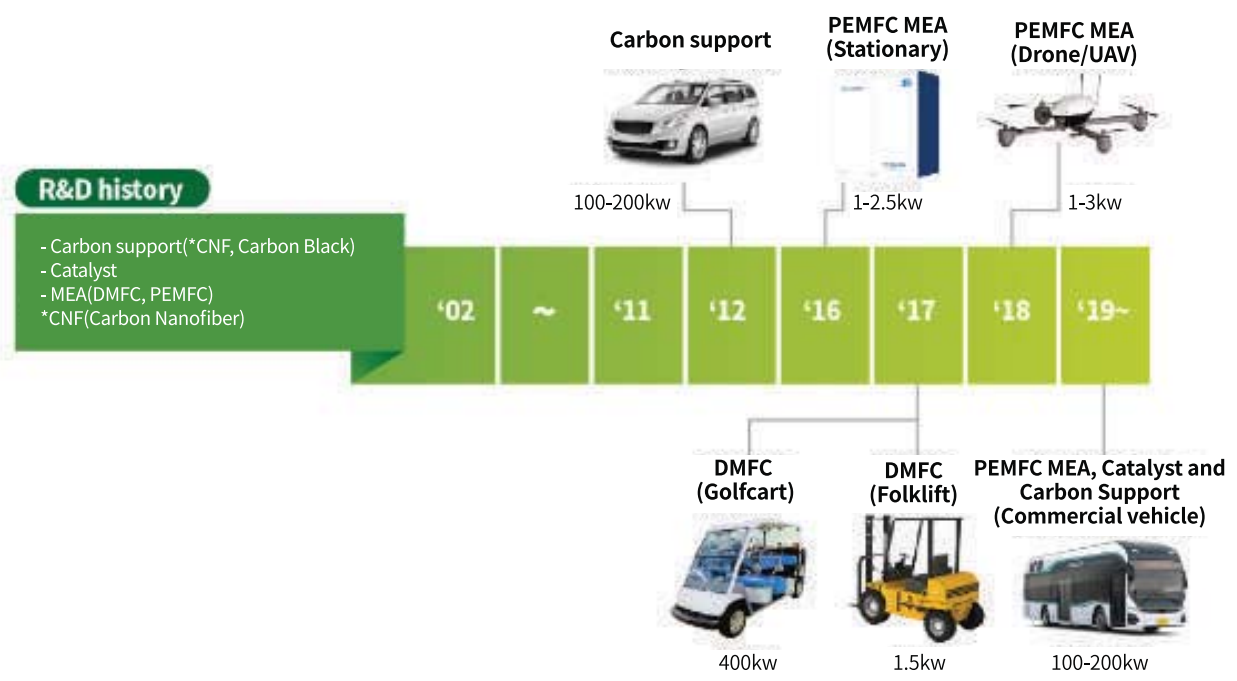
VINATech advanced Membrane Electrode Assembly(MEA)

It is made with carbon support and catalyst have high power and durability

VINATech has started the fuel cell components business from 2002. We are manufacturing our own carbon support, catalyst and PEMFC / DMFC-MEA. VINATech products, carbon support, catalyst and the MEA, can be used for all kinds of applications(stationary and vehicle etc.). Based on our patented carbon technology, VINATech is committed to developing new products and technologies to provide the world class quality.



Fuel cell division development history



11.VINATech Fuel Cell Material

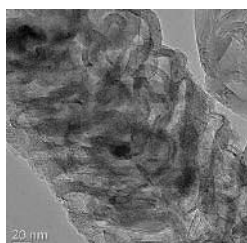
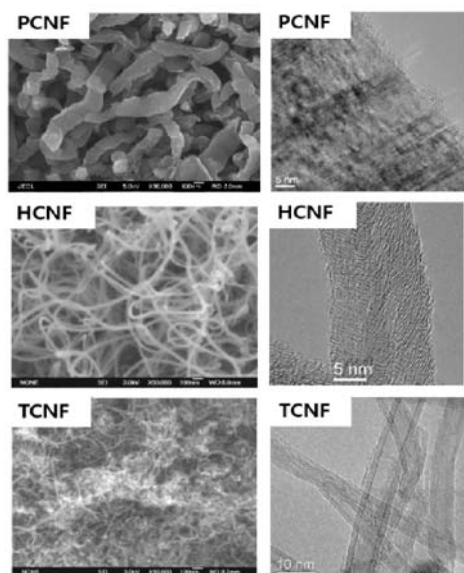
Carbon support

- Various shapes of carbon nanoparticles
- High electrical conductivity
- High anti-corrosion : high crystallinity and surface area
- Uniform edge surface: high affinity and catalyst
- High mesopore ratio

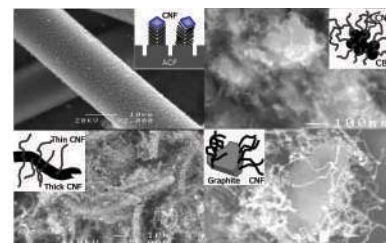


Division	BET(m ² /g)	XRD(d ₀₀₂ , nm)	Type	Shape of particle
VES-PL0100	60~70	0.336-0.338	CNF	Platelet
VFS-HE0150	100~150	0.340-0.345	CNF	Herringbone
VFS-SP0450	400~500	0.345-0.355	Carbon black	Sphere
VFS-SP0750	700~800	0.345-0.355		

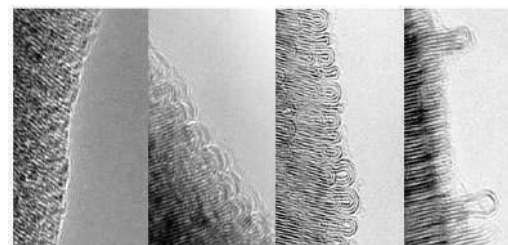
Carbon Nanofibers



Mesopore formation

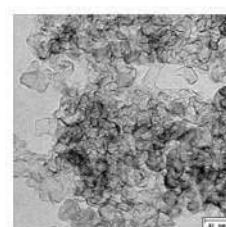
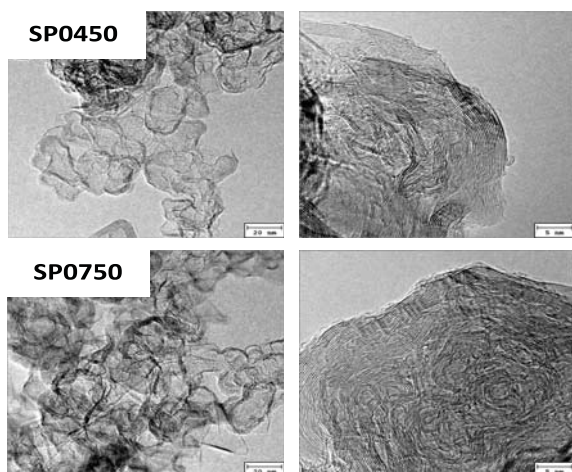


Hybrid technology

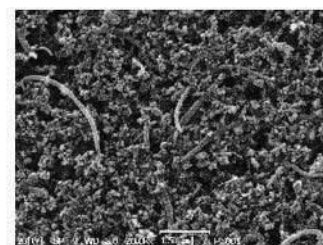


Surface and Edge Control

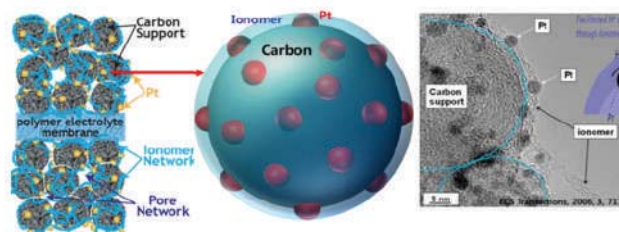
Sphere carbon black



High Surface area



Hybrid technology



Optimum electrode structure

* Sassin et al., Anal. Chem. 2017
 * ECS Transactions, 2006, 3, 717

11.VINATech Fuel Cell Material

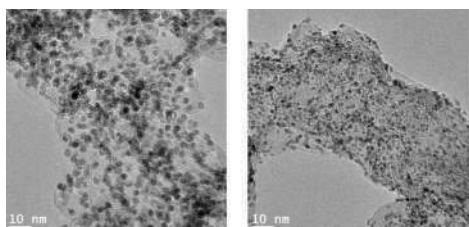
Catalyst

- High reactivity and durability
- Electrochemical Surface Area(ECSA) and good metal stability
- Narrow particle size distribution

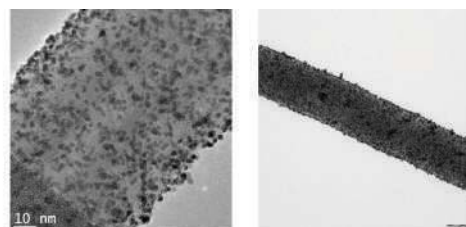


Division	Pt content(%)	ECSA(m ² /g)	Particle size(nm)	Support type
VFC-HE	20~60	30~45	2.5~2.8	Herringbone
VFC-SP		50~60	2.5~3.0	Carbon black

VFC-SP



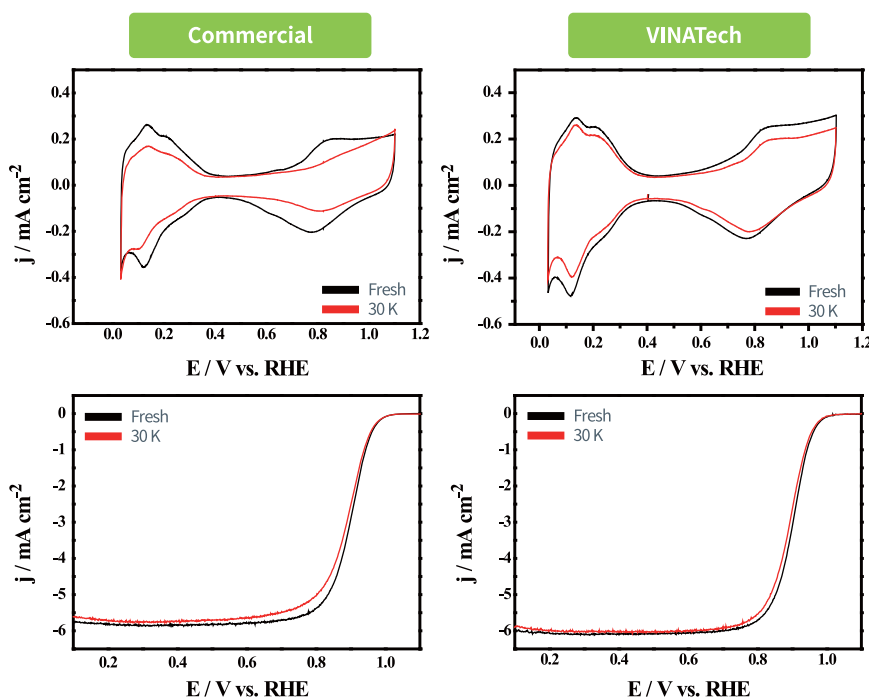
VFC-HE



Performance and Durability of Catalyst

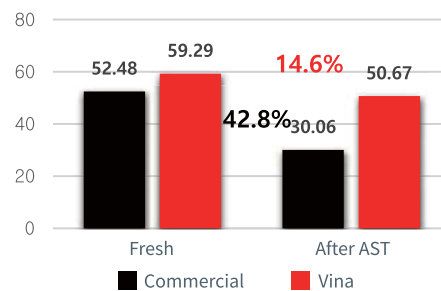
Electrochemical analysis in Half cell

Operating environment durability test (0.6 V(3s) - 0.95 V(3s), 30k cycling, DOE Standard)

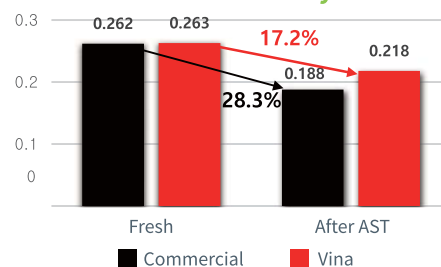


※ AST: Accelerated Stress Test
 ※ DOE : Department Of Energy

Electrochemical Surface Area



Mass Activity



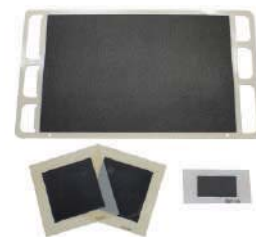
**VINA Tech's catalyst durability meet DOE standard.
 Test results show our catalyst has good performance and metal stability.**



11.VINATech Fuel Cell Material

MEA(Membrance Electrode Assembly)

- Available to PEMFC&DMFC
- High reliability and durability
- High performance at any environments
- Customized lazer(CCM, 5, 7)



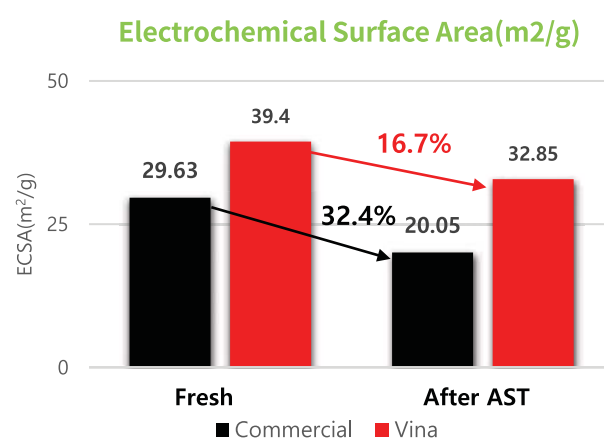
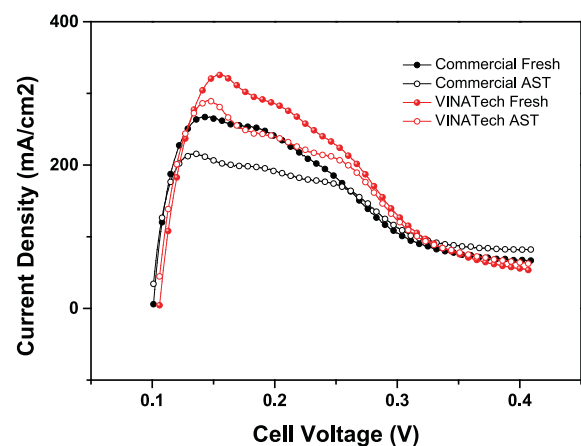
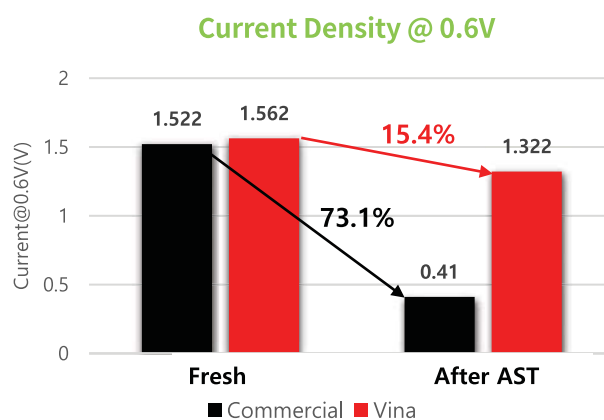
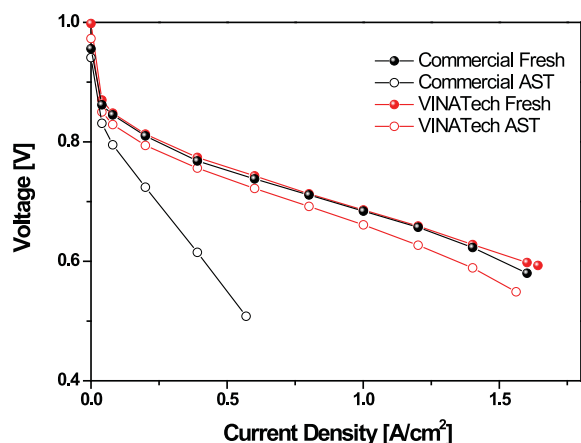
Product	Application	Available form	Size	
PEMFC	Transport, Stationary, Portable	CCM and 5, 7 layer	Customization -450 cm ²	
DMFC	Portable, Back-up power	5 layer		
Division	PEMFC			DMFC
	Transportation	Stationary	Drone	Forklift, Portable
Performance	0.25 A/C.@077V @1 bara	2 A/C @ 0.6V @ 2 bara	0.5 A/C @ 0.72V @ 1 bara	0.2 A/C@ 0.48 V @1bara
Durability	>5,000hr (DOE standard)	> 26,240 hr (10% degration, 3.5uV/hr)	> 5,000hr	>5,000hr
Operating Conditions	50-95 °C 0-100% RH	60-80 °C 100% RH	50-70°C 0-50 % RH	60-80 °C 0% RH(cathode)

Performance and Durability of MEA

Electrochemical analysis in MEA Single cell

High voltage durability test (1.0-1.5 V, 500 mV/s, 5k - 10k cycling, DOE modified)

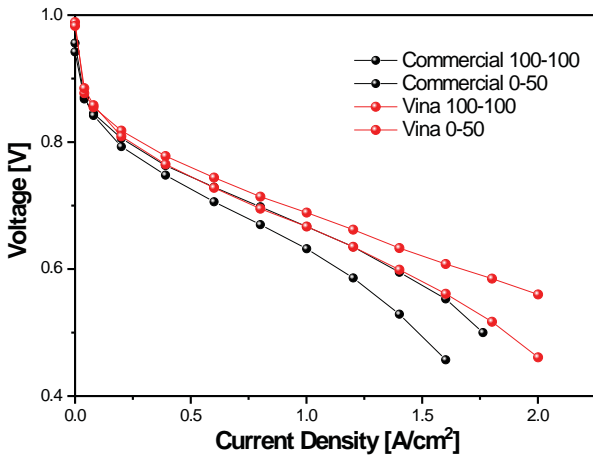
Temperature : 60°C
 Pressure : An / Ca = 1 bar / 1 bar
 Flow : H₂ / N₂ = 200cc / 600cc
 RH : An / Ca = 100% / 100%
 Cycle : 500 mV/s (1.5 - 1.0V, 5k cycling)



Low humidity Performance of MEA

Electrochemical analysis in MEA Single cell

Single Cell MEA I-V Curve at low humidity



Test Condition

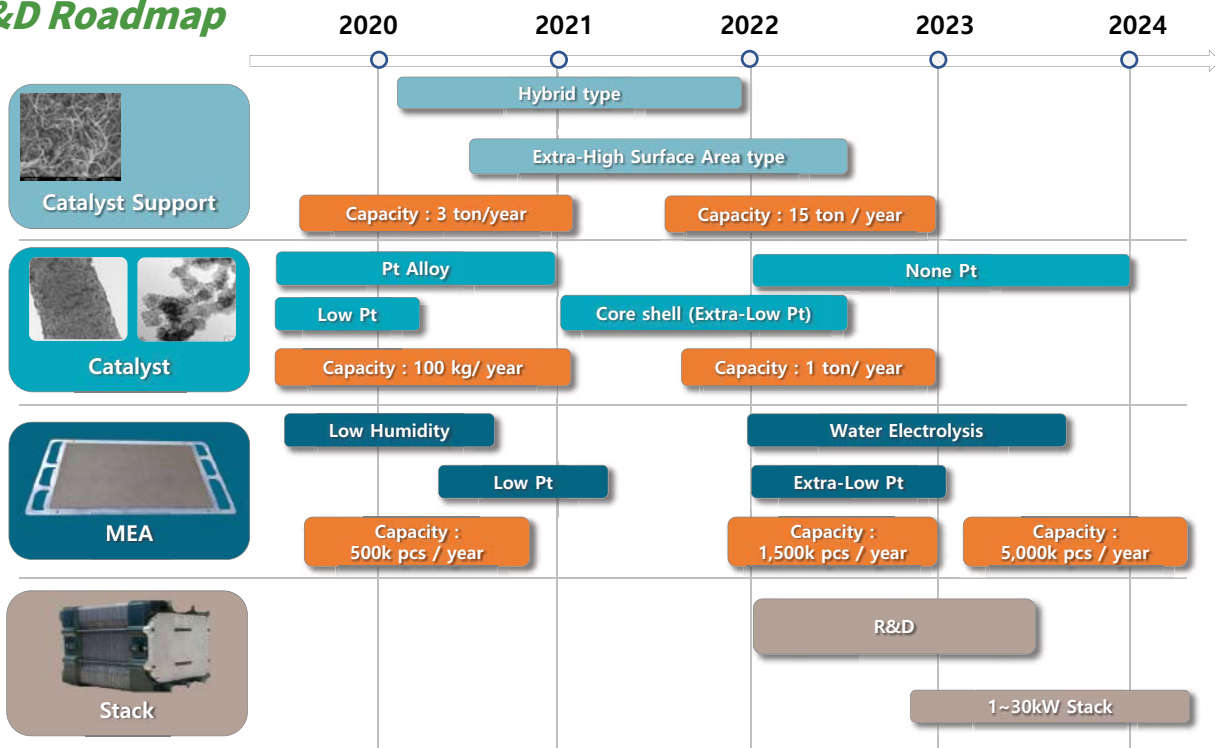
- ✓ Temperature : 60°C
- ✓ Pressure : An / Ca = 1 bara / 1bara
- ✓ Flow : H2 / Air = ×1.5 / ×2.0
- ✓ RH : An / Ca = 100% / 100%
0% / 50%

MEA Specification

- ✓ 25cm² Single Cell

Division	RH %	mV @ 250 mA/cm²		mV @ 1,000 mA/cm²		mV @ 1,500 mA/cm²	
		Value	% Change	Value	% Change	Value	% Change
Commercial	100-100	794	2.1% ↓	667	5.3% ↓	565	13.2% ↓
	0-50	778		632		496	
VINATech	100-100	806	1.4% ↓	689	3.2% ↓	628	8.0% ↓
	0-50	795		667		578	

R&D Roadmap



Please contact VINATech sales office for any customized design, changing size, material, electrode, membrane electrode assembly property control, and including the above, you can come up with any innovative idea, VINATech R&D engineers awaits your suggestions.

We promise that our customers will be our highest priority as we believe that we can only exist as long as our customers do.



ABOUT VINATech

World Leading Manufacturer of Supercapacitors and Fuel Cell Materials

VINATech challenges new technologies and new products by constant change and effort.

VINATech research and development lab works on supercapacitors and fuel cell materials based on R&D system for new technology and new products for next generations and future growth.

It is applied to as many as areas from Social Infrastructure for building Smart Cities to Hydrogen Fuel Cell related areas.



CUSTOMERS ARE THE REASON FOR OUR BUSINESS.

Product design and specification are subject to change without notice. Contact us for the current technical specifications before purchasing products.



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