

From Power Conversion to **Grid Forming**

Enabling the Next Generation of
Solar & Storage Plants

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Active Grid Plants Need One Technical Interface

Higher IBR shares raise grid expectations; GoodWe UBU meets them from requirements to lifecycle support.

WHAT THE GRID NOW EXPECTS

TRADITIONAL ROLE

01 Convert and deliver energy

02 Follow an established grid

03 Optimize individual equipment

EMERGING ROLE

→ **Deliver energy and grid services**

Support voltage, frequency and resilience

→ **Operate in weaker grids**

Remain stable as grid strength declines

→ **Coordinate at plant level**

Translate devices into system capability

HOW UBU DELIVERS IT: ONE TECHNICAL INTERFACE

01 Project Requirements

Grid requirements · System architecture · Equipment configuration

02 Solution Engineering

PV inverters and PCS · MVS and ICS · Plant-level coordination

03 Project Delivery

Factory integration · Commissioning · Grid connection support

04 Lifecycle Support

Global service · Remote diagnostics · O&M support



Power conversion expands from energy delivery to **system stability** — made real through **engineering and delivery**

One Platform from PV Conversion to the MV Grid

UT string inverters, string PCS / ICS and MV stations — one supplier from DC input to the MV grid.

PV CONVERSION

UT Series · 250/350 kW · 1500 V



99.01%

Max efficiency · up to 15 MPPTs

20 A

Per string · 24/30 DC inputs

>40 °C

Full-power operation · IP66, C5-H

SCR > 1

Stable under weak-grid conditions

DNV | TECHNOLOGY REVIEW
Independent assessment of the UT Series
Independent technology review

STORAGE CONVERSION

GW215K-PCS-G10 string PCS · ICS



98.8%

Max efficiency

1.1×

Continuous overload

SCR 1.0

Weak-grid operation

P/Q

Fast control · foundation for GFM

ICS = string PCS + step-up transformer + optional 24 kV SF₆-free RMU, factory-integrated

MV INTEGRATION

MV Station · 20-ft LV-to-MV block



3.5–9 MVA **20-ft**

Ratings: 3.5 / 5 / 7 / 9 MVA

Containerized, easy transport

IP54

Optional C5-M corrosion protection

LV → MV

Pre-assembled, type-tested components

PV arrays → UT inverters → MV station → MV grid

High-yield conversion → controllable storage → **integrated MV delivery**

GRID FORMING

Efficient Conversion Is No Longer Enough

When the external grid reference weakens,
power converters must do more than inject energy.

LOWER INERTIA

WEAKER GRIDS

FASTER DYNAMICS

The next step is **active grid stability.**



Grid-Forming Changes the Converter's Fundamental Control Behavior

Grid-following responds to an external reference. Grid-forming helps establish that reference.



Controlled **Current Source**

- ✓ Synchronizes to an existing voltage waveform
- ✓ Typically uses PLL-based synchronization
- ✓ Depends on an established AC grid reference

Controlled **Voltage Source** Behind an Impedance

- ✓ Establishes internal V, f and phase reference
- ✓ Supports weak-grid operation and defined standalone modes
- ✓ Contributes autonomously to voltage and frequency stability

GFL and **GFM** will coexist, with control modes selected for grid conditions and project requirements.

GoodWe Integrates Six Grid-Forming Functions on One PCS Platform

GW215K-PCS-G10 | Voltage-source mode | VSG-based control



01 V/f Support

- Voltage-source behavior
- Autonomous V & f reference



02 Inertia Response

- Virtual inertia
- Fast active-power response



03 P-f / Q-V Response

- Primary frequency response
- Primary voltage regulation

Six Functions One PCS Platform



04 Oscillation Damping

- Low-frequency damping
- Wide-band positive damping



05 Fault Support

- LVRT / HVRT
- Reactive-current support



06 Black Start & Islanding

- Up to 24 PCS in parallel
- Off-grid operation & transition



ms-level response

0.2–2.5 Hz oscillation suppression

LVRT / HVRT functional tests

Up to 24 PCS in parallel

Grid-Forming Requirements Across Key Markets

China has implemented requirements. European markets are defining technical and validation pathways.

 CHINA IMPLEMENTED Requirements are already in place KEY FRAMEWORK CQC-PV15001-2024 Technical Specifications for Grid Connected Storage Converters DEPLOYMENT SIGNAL Grid-forming technology deployed in multiple projects FOCUS System stability, fault support, inertia, voltage and frequency support, and black start	 GERMANY REQUIREMENTS AVAILABLE KEY FRAMEWORK FNN Grid Forming Requirements V2.0 (2025) TR3 / TR4 / TR8 certification schemes FOCUS Voltage-source behavior, inertia, damping, fault current support and phase jumps	 SPAIN REQUIREMENTS AVAILABLE KEY FRAMEWORK REE Especificación Técnica de Capacidades Grid-Forming, ET GFM (2025) FOCUS Voltage and frequency support, inertia, FRT, black start and GFM/GFL switching
	 ITALY REQUIREMENTS AVAILABLE KEY FRAMEWORK Terna Test Guidelines for Grid-Forming BESS Systems (2024) FOCUS Voltage-source converter tests, stability, inertia, fault support and islanding	 GREAT BRITAIN REQUIREMENTS EVOLVING KEY FRAMEWORK NESO Grid Code modifications GFM technical requirements under development FOCUS Inertia, fault response, voltage control and black start
	 EU FRAMEWORK UNDER DEVELOPMENT ACER RfG 2.0 draft ENTSO-E GFM Capability of Power Park Modules draft FOCUS A harmonized approach across EU Member States	

Markets Are Converging on the Core—Verification Still Differs

Core GFM capabilities are broadly aligned. Test methods and additional requirements remain market-specific.

- Explicit requirement
- ◐ Conditional or project-specific

COMMON CORE CAPABILITIES	 CHINA	 GERMANY	 SPAIN	 ITALY	 GREAT BRITAIN
① V/f SUPPORT VOLTAGE SOURCE BEHAVIOUR	●	●	●	●	●
② INERTIA RESPONSE	●	●	●	●	●
③ P–f / Q–V RESPONSE	●	●	●	●	●
④ OSCILLATION DAMPING	●	●	●	●	●
⑤ FAULT SUPPORT / FRT	●	●	●	●	●
⑥ BLACK START / ISLANDING	●	◐	◐	●	◐

MARKET-SPECIFIC REQUIREMENTS

PHASE JUMP	CURRENT LIMITATION	OVERLOAD CAPABILITY	PASSIVITY / IMPEDANCE STABILITY	GFM ↔ GFL SWITCHING	EMT / RMS MODEL VALIDATION
CN DE ES IT GB	CN DE ES IT GB	CN DE ES IT GB	CN DE ES IT GB	CN DE ES IT GB	CN DE ES IT GB
● ● ● ● ●	● ● ● ◐ ●	● ◐ ◐ ◐ ◐	● ● ◐ ● ●	● ◐ ● ● ◐	◐ ● ● ◐ ●

 China: GB/T 47655-2026
Grid Connected Storage Converters

 Germany: FNN V2.1 (2024)
TR3 / TR4 / TR8 schemes

 Spain: REE ET GFM (2025)

 Italy: Terna Test Guidelines (2024)

 Great Britain: GC0137 (2022)
ESO Best Practice Guide (2023)

A common control platform still requires market-specific models, thresholds and certification.

GoodWe Has the Core Functions; Market Compliance Is the Next Gate

GW215K-PCS-G10 functions and tests establish the technical base. Each market still requires its own models, thresholds and certification path.

CORE FUNCTIONS IMPLEMENTED AND FUNCTIONALLY TESTED			MARKET COMPLIANCE GATE	
FUNCTION	GOODWE IMPLEMENTATION	TEST EVIDENCE		
✓ V/f Support	Autonomous voltage-source control Stable voltage and frequency reference	VSG control strategy Section 1.1	○ AVAILABLE AND TESTED ● Current limitation ● GFM ↔ GFL transition	
✓ Inertia Response	Virtual inertia emulation Millisecond-level active-power support	Inertia response tests Section 1.6	○ MARKET VALIDATION REQUIRED ● Phase-jump response ● Overload capability ● Passivity / impedance stability	
✓ P–f / Q–V Response	Configurable droop characteristics Primary frequency and voltage control	P–f: Section 1.2 Q–V: Section 1.3	○ CERTIFICATION ACTIVITY ● EMT / RMS model validation	
✓ Oscillation Damping	Low-frequency and wide-band damping Designed to improve system stability	0.2–2.5 Hz and wide-band Section 1.7		
✓ Fault Support / FRT	LVRT / HVRT with reactive-current support Dynamic short-circuit current limitation	0.1–1.3 pu, SCR = 10 Section 1.8		
✓ Black Start / Islanding	Autonomous black start and stable off-grid operation Supports large off-grid systems	24 PCS in parallel Sections 2.1 and 2.2	Market acceptance still depends on country-specific models, test procedures and certification.	

GoodWe has implemented the core functions. Each market now sets the validation and certification path.

GoodWe UBU Connects Technology, Engineering and the Grid

Across utility-scale solar and storage, we combine efficient conversion, integrated delivery and grid-forming control.

ONE UTILITY-SCALE PARTNER

From plant design and grid connection to commissioning and long-term operation

GOODWE UBU CAPABILITIES

Backed by GoodWe's global R&D, manufacturing and service network

01

TECHNOLOGY PLATFORM

PV inverters, bidirectional PCS and intelligent controls

02

INTEGRATED ENGINEERING

MV Station, factory-engineered ICS and plant architecture

03

GRID CAPABILITY

Fast P/Q response, weak-grid operation and grid-forming control

04

LIFECYCLE DELIVERY

Commissioning, global service, remote diagnostics and O&M support

Building reliable, grid-ready plants with our customers and partners

Thank You

Questions & Discussion

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