

The Role of Programmable AC & DC Supplies in Modern Energy Systems

Erkan Sezen

Field Application Engineer
TDK-Lambda Europe

Agenda

- **Programmable AC power supplies as grid emulator**
- **The role of programmable and bidirectional DC power supplies in modern DC architecture**
- **Realistic test and validation of ESS and BESS systems, including**

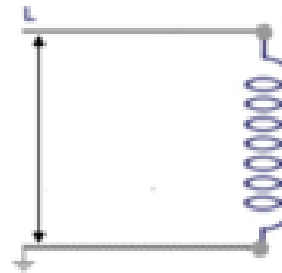
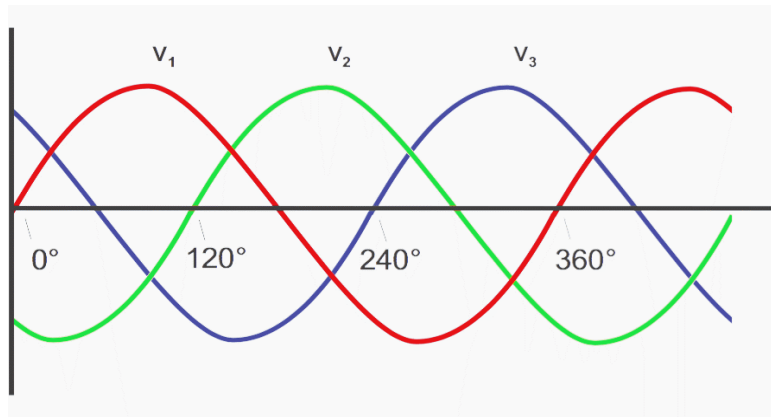
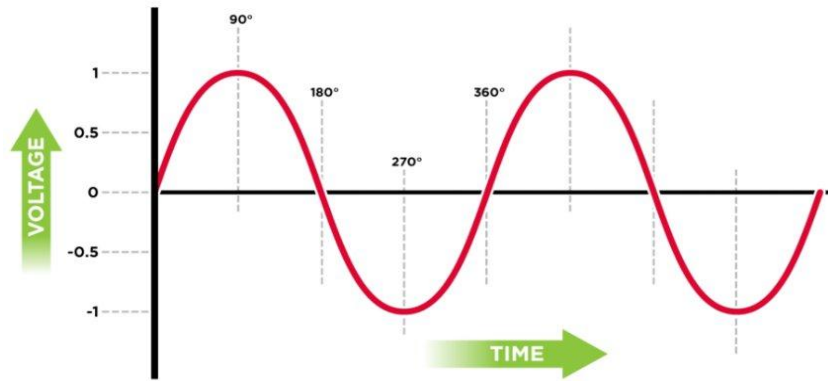
Programmable AC power supplies as grid emulator

- Multi phase Programmable output
- Advantage Parallel and booster option
- Autoranging
- Harmonics, THD
- High Crest Factor Capability
- Amplifier Mode
- Integrated Standards Libraries

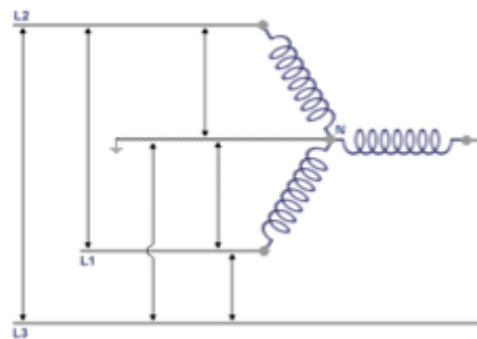


Programmable AC power supplies: capabilities overview

Multi-phase programmable output (single, three-phase)



L-N: 0-xxxVac



L1-N: 0-xxxVac
L2-N: 0-xxxVac
L3-N: 0-xxxVac

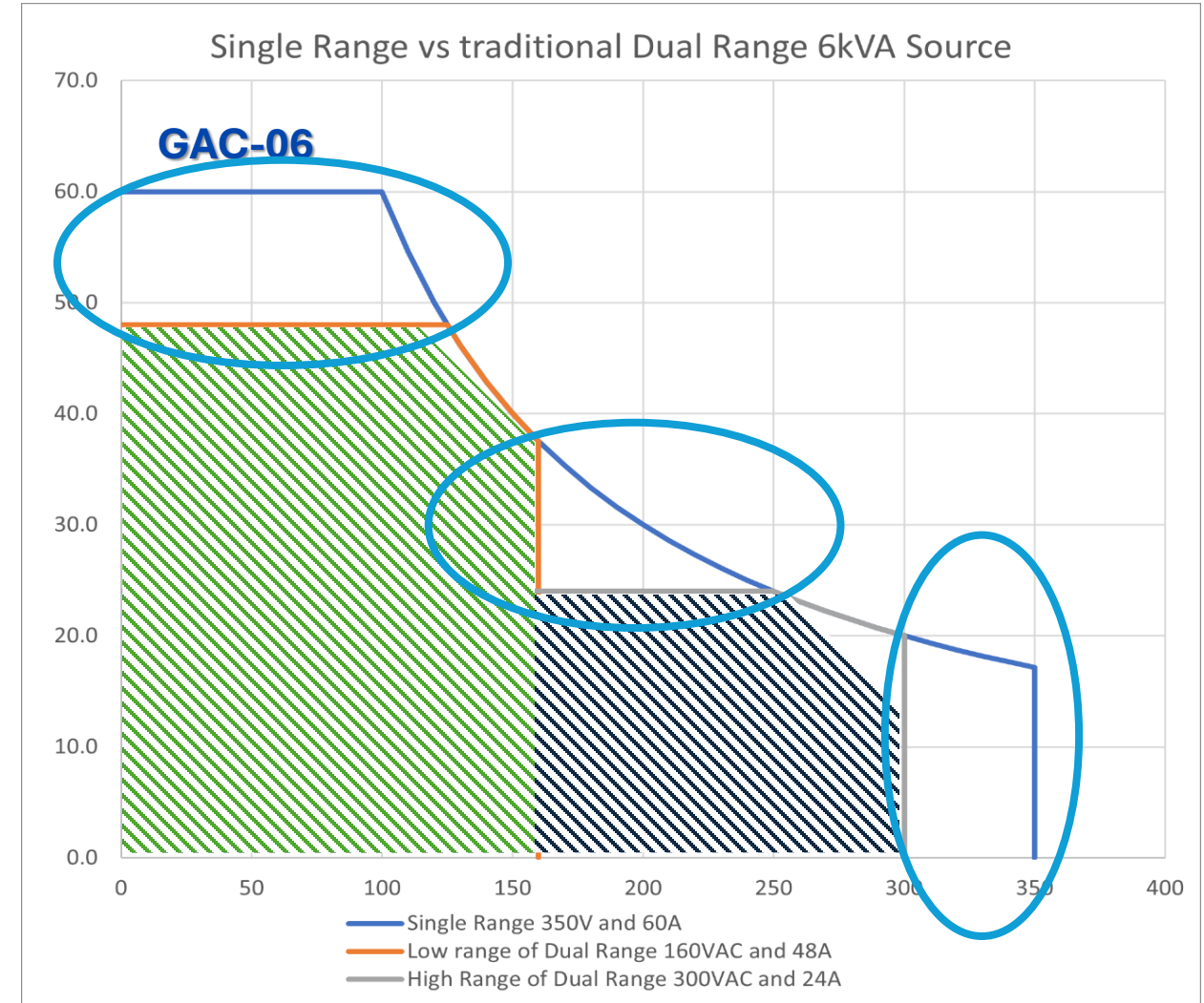
- In a 120° Phase- shifted 3-Phase sinusoidal Waveform
- Some frequently used voltage levels:
208V L-L = 120 V ph (US Line)
400V L-L = 230V ph (EU Line)
480V L-L = 277V ph (US/ Industrial Line)

GAC Series _Back side:

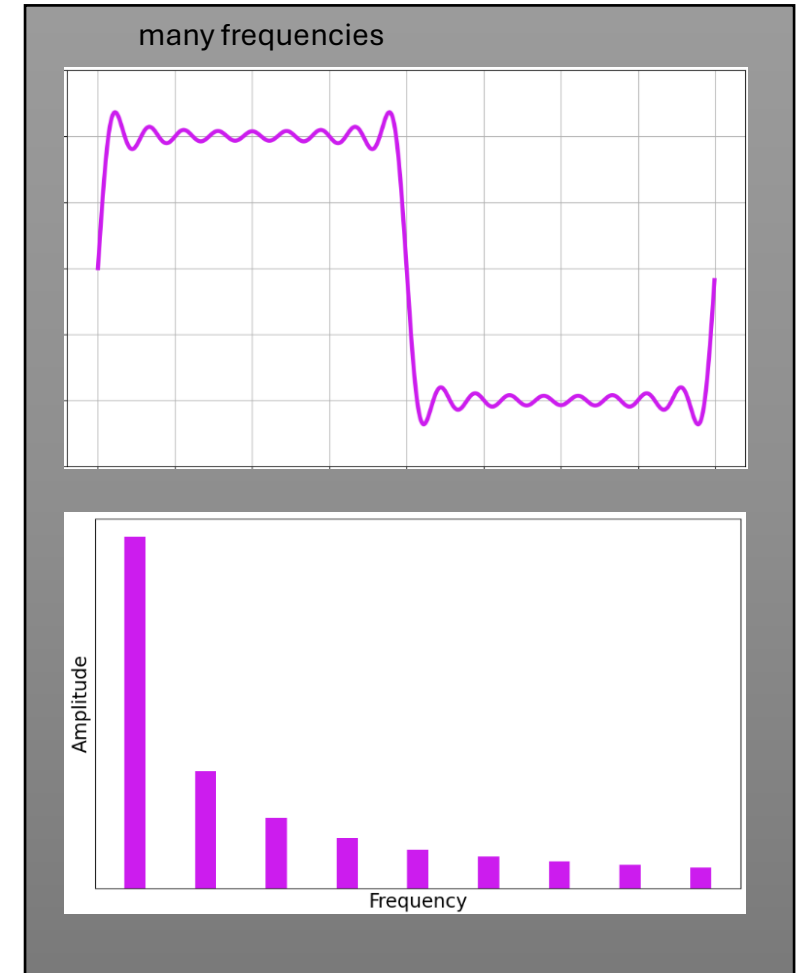
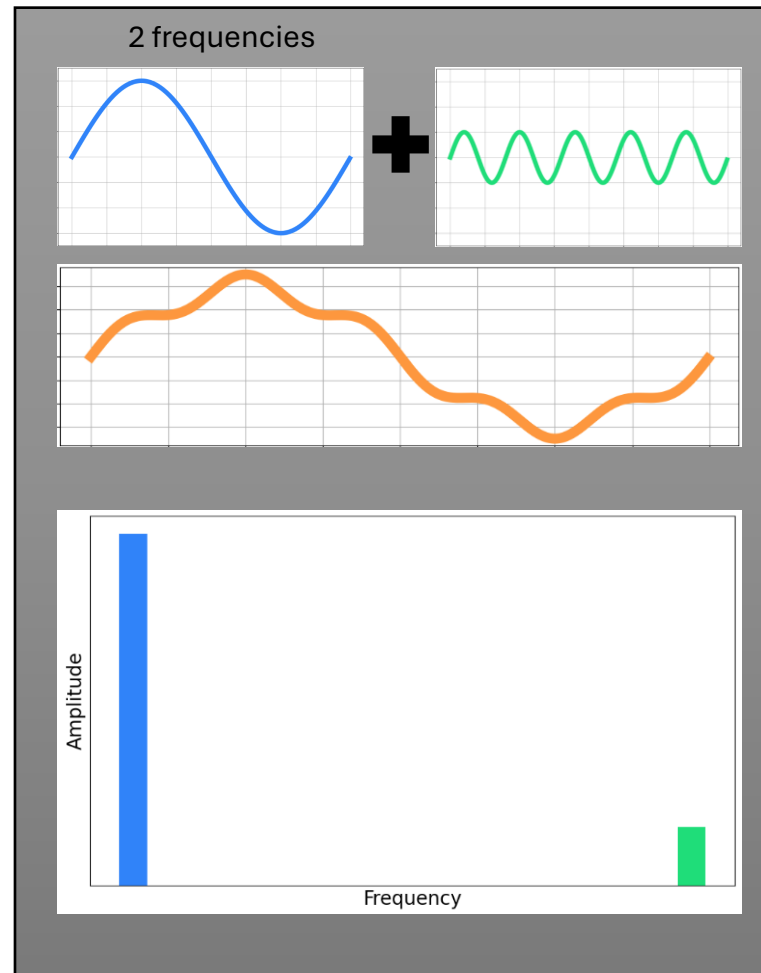
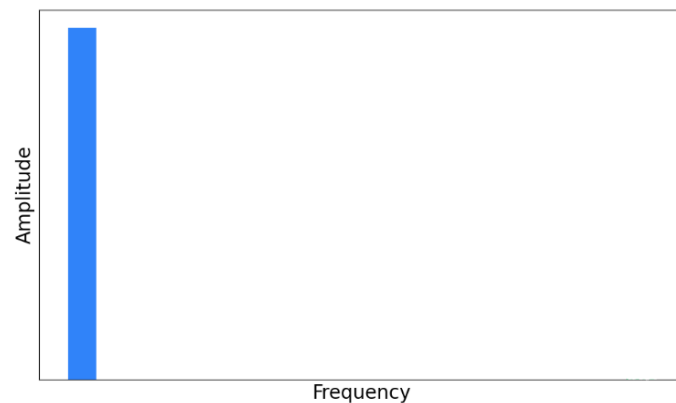
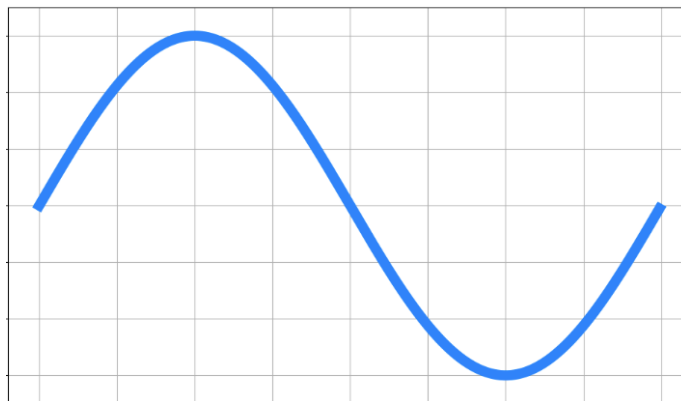


Autoranging Operating range

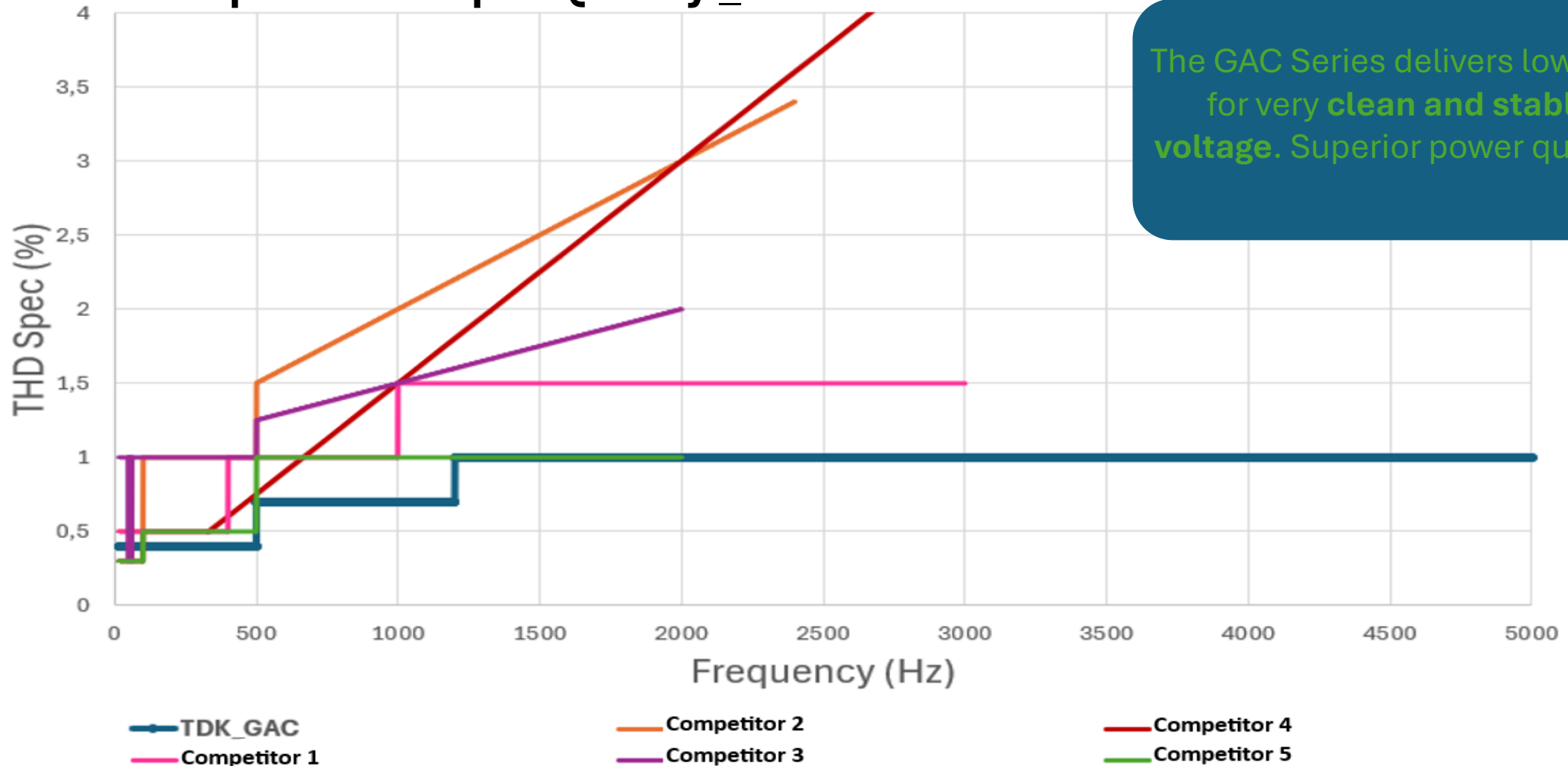
- ▶ Here a popular, **Dual Range AC source** compared to a the GAC-06 **single range** model.
 - ▶ AC output single range of our GAC-06
 - ▶ The High range of the Dual range (0-300V)
 - ▶ The LOW range of the Dual range (0-150V)
- ▶ **Advantage of single range output:**
 - ▶ A **wide voltage and current output** range available from single unit
 - ▶ Excellent for fast changing loads



AC Terms-Harmonics



Exceptional Output Quality _ Ultra Low THD



The GAC Series delivers low THD for very **clean and stable voltage**. Superior power quality.

High Crest Factor Capability

The Crest Factor measures a source's ability to deliver short, high-current peaks without distortion.

► **Key Points:**

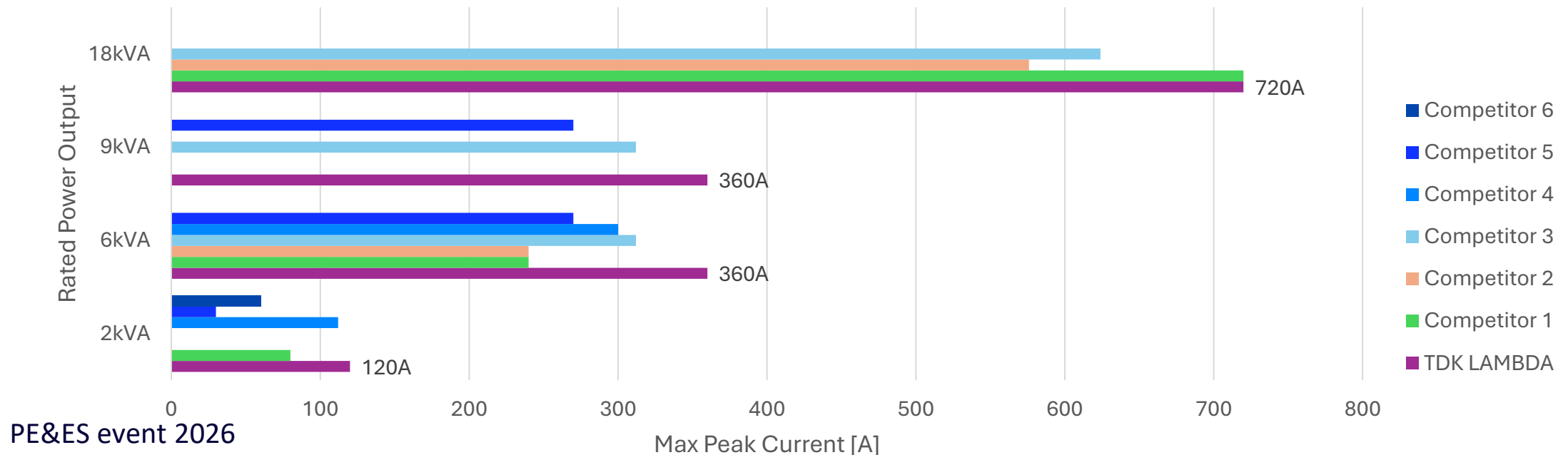
Up to 6:1 Crest Factor for true peak reproduction

► **Deliver peak current** without waveform distortion

► **Ideal for non-linear devices** (inverters, LED drivers, motors, inductive loads...)

Crest Factor: I_{peak}/I_{rms}

Peak Current Capability / Total Output



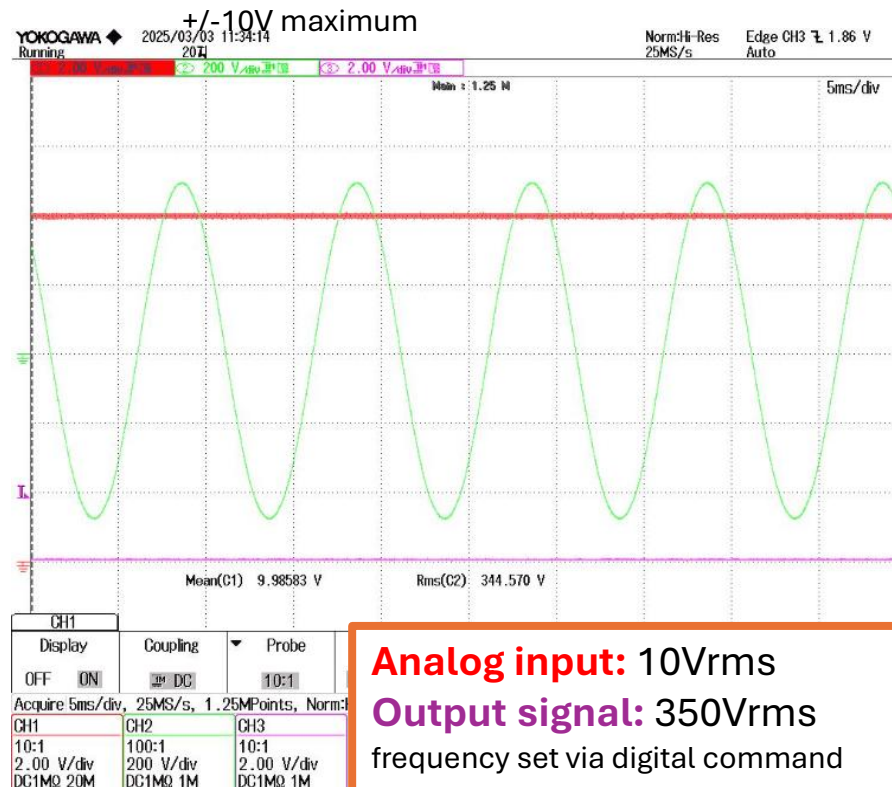
Amplifier Mode

GAC vs GAC-PRO _ Two Approaches to Analog control:

GAC analog input: controls output amplitude (Rms)

0-5V or 0-10V range _ you can select AC voltage or Frequency settings

GAC-Pro amplifier mode: output an exact replica of the analog signal,
scaled in voltage and frequency



Integrated standard libraries



Avionics

- RTCA/DO-160, ABD100.1.8.1(AIRBUS)
- Frequency variation, Voltage Fluctuation, Transients, Harmonics...



IEC/ Industrial

- IEC61000-4-11, 4-13, 4-14, 4-17, 4-27, 4-28, 4-29, 4-34
- Voltage Dips, Short Interruptions, Harmonics & Interharmonics...



Military & Defense

- MIL-STD-1399 (navy), MIL-STD-704 (avionic)
- Voltage surge, Unbalance, harmonics distortion...

KEY BENEFITS



Pre-Programmed test sequences



Faster compliance and qualification



Reduced configuration errors

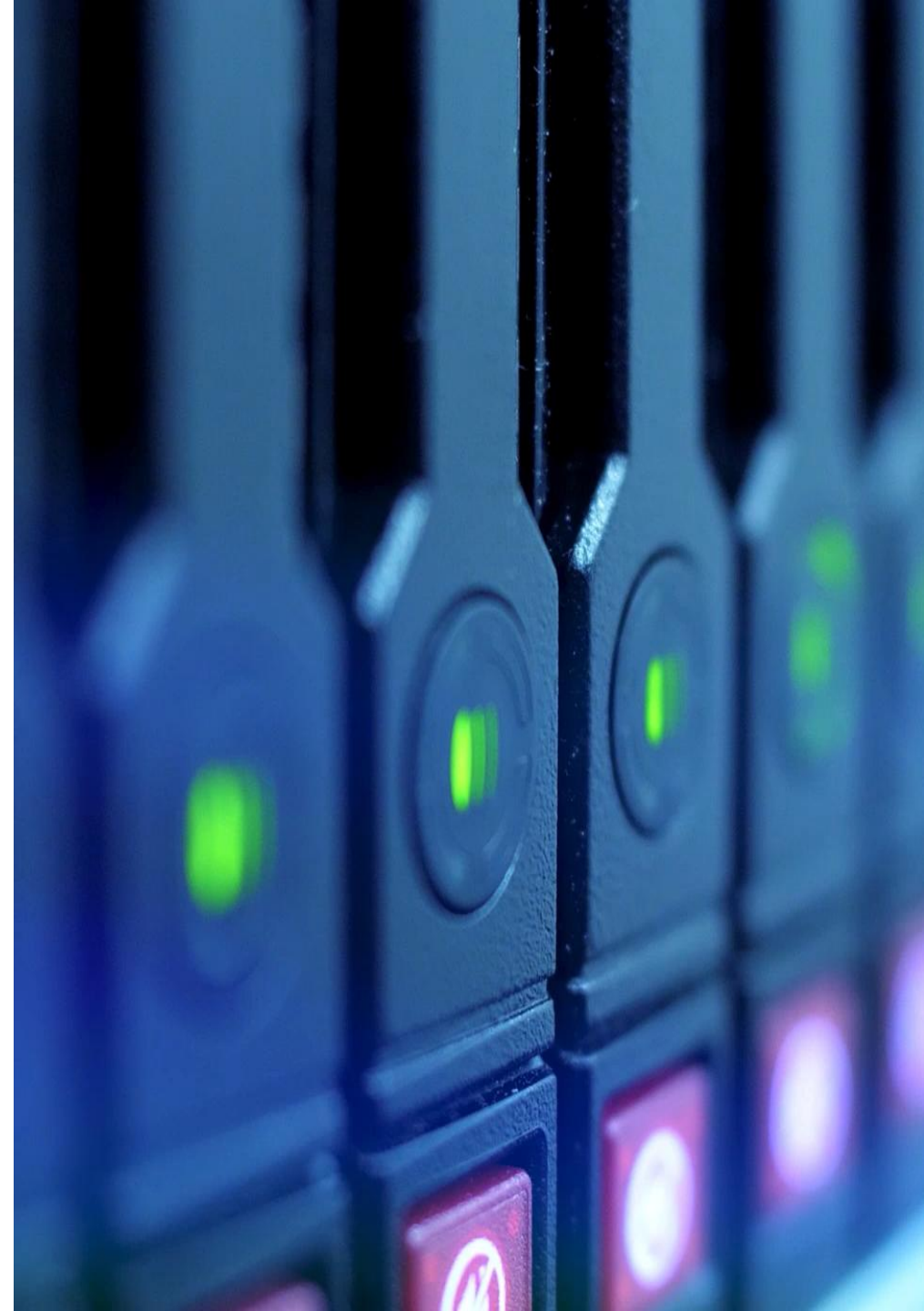


Reproducible and standardized results



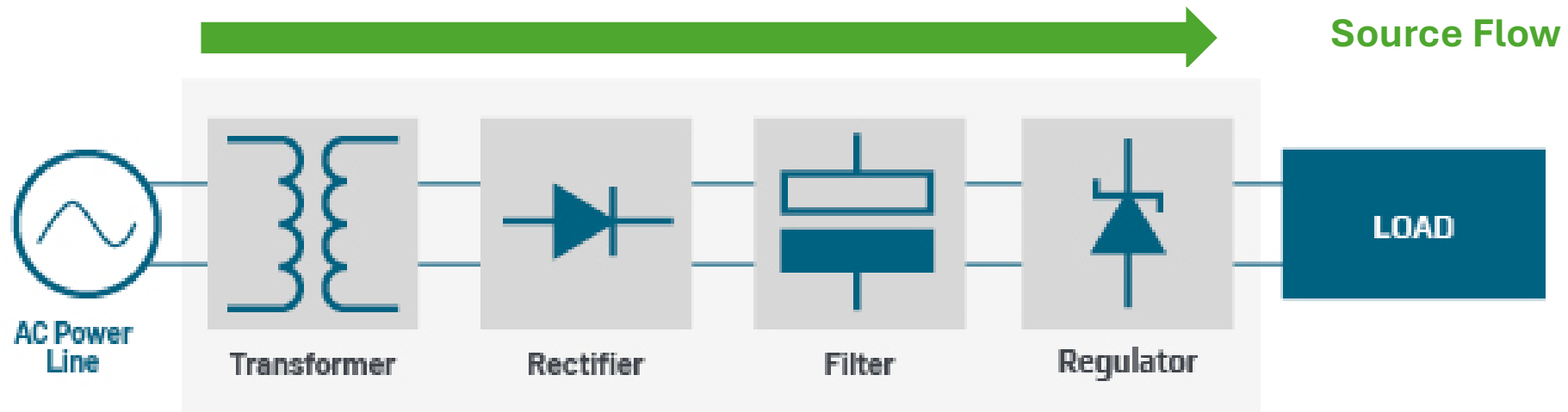
Programmable & Bidirectional DC Supplies

- ▶ Programmable DC Power Supplies how it works
- ▶ Constant Power Output Mode
- ▶ Sequencing + Arbitrary Waveforms
- ▶ How a Bidirectional DC Power Supply Works
- ▶ Testing an EV DC/DC Converter example
- ▶ High power Solution DC



How a DC Power Supply Works

Inside a Power Supply: Energy Flow & Control



Source

Source Mode → **Supplies** Power to the DUT

Up to 7.5kW in
1U height

Air intake
front to rear airflow

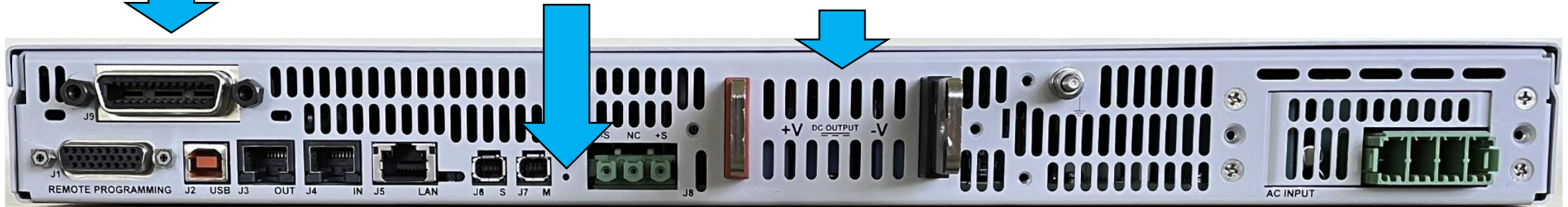
High contrast, wide viewing angle
16 segments LCD



Options slot

Output terminals All Models
Rugged busbar output up to 1500V

User friendly menu



Analog signals

USB

RS232/485

PE&ES event 2026

LAN (LXI 1.5)

Sense connector (header & plug)

Paralleling connectors

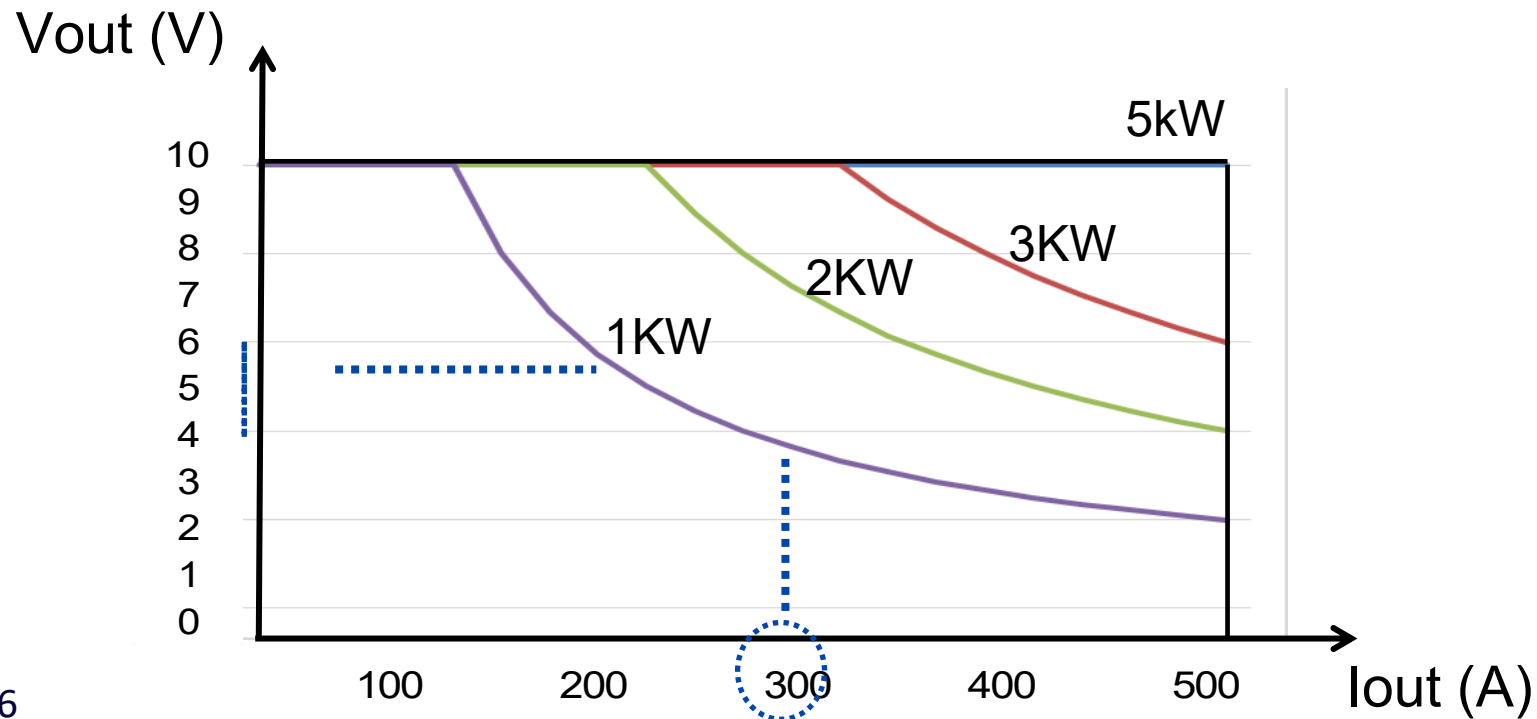
Input connector
(header & plug)
400/480VAC

Programmable Power Supply GENESYS+ 7.5kW Front & Rear View

Power Limit (CP Mode)

❖ CV/CC/CP modes:

- Genesys+ can operate as a Constant Voltage, Constant Current or Constant Power Limit mode
- Constant Power Limit can be set via front panel or communication interface to limit output power
- CP mode supports both Foldback **CV or CC**
- User selectable Voltage Limit & Current Limit settings



technologiebranches

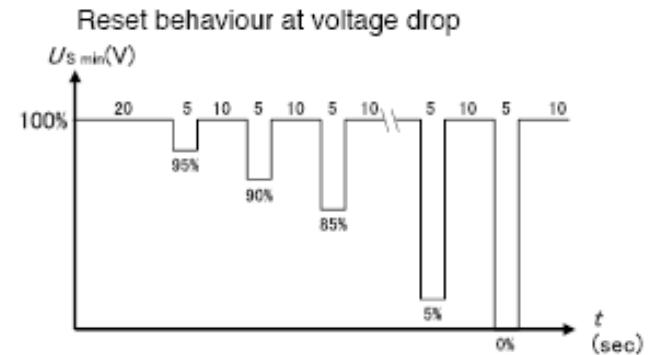
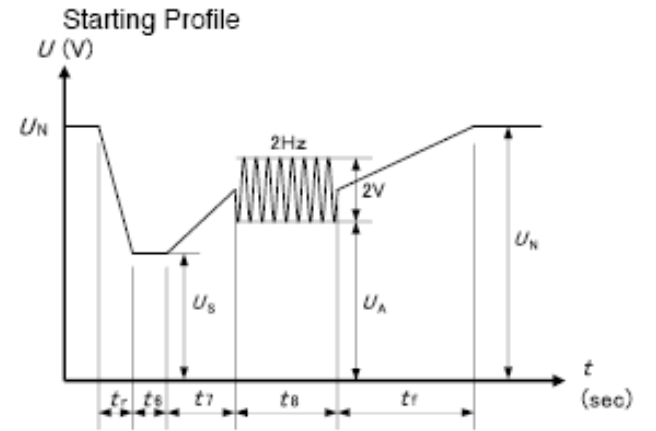
Sequencing + Memory

❖ Arbitrary Waveforms:

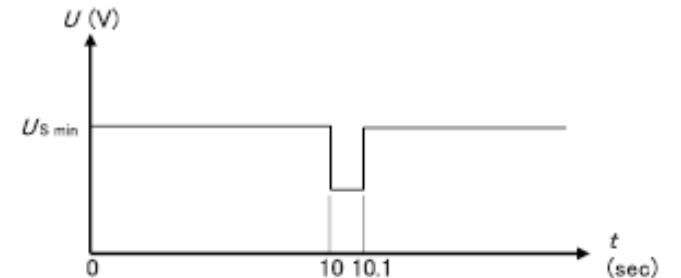
- Output voltage / current can be programmed to generate arbitrary waveforms
- Different waveforms of up to **100 steps** can be stored in **4 memory cells**, called by communication commands or front panel

Profiles such as car battery simulation at start or voltage drops (dips) to test electrical components can be generated

Active memory cell number and activity indicator is seen on the front panel

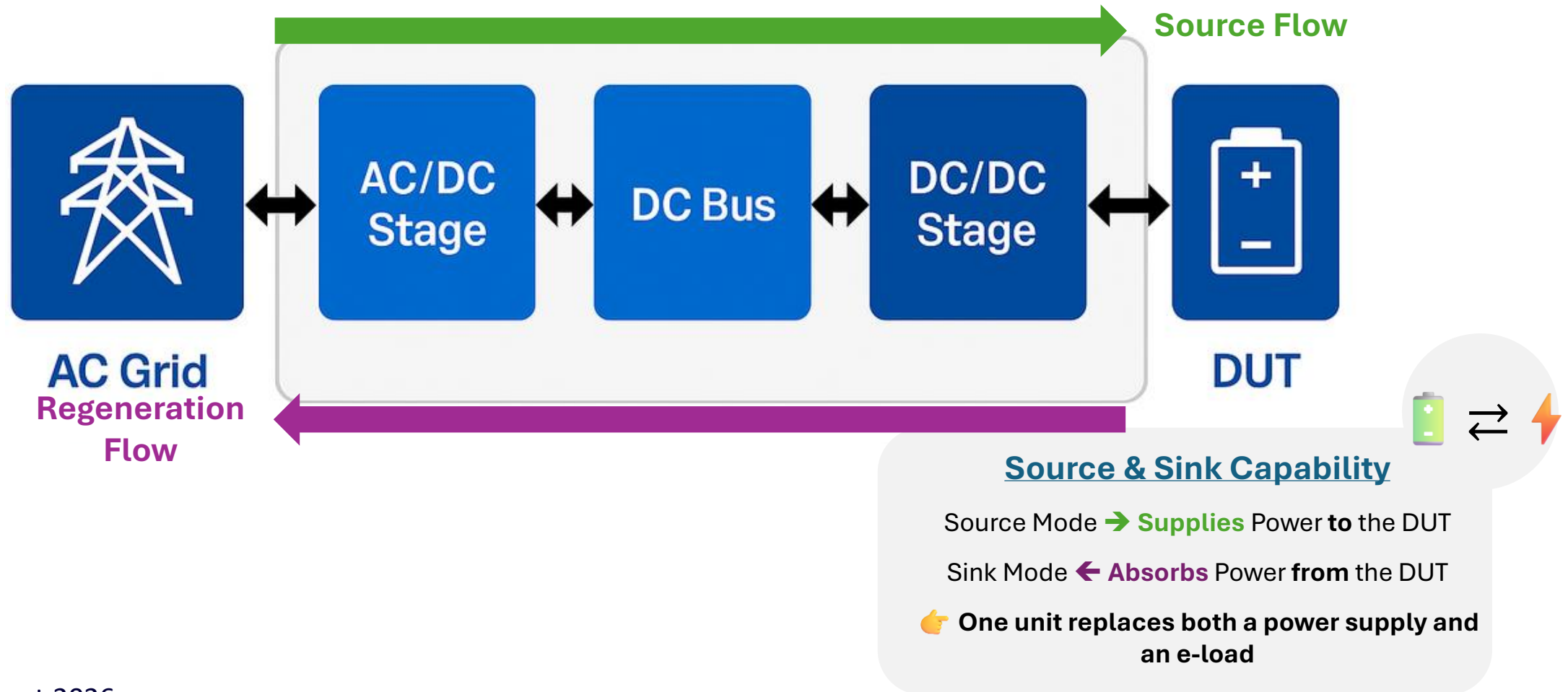


Discontinuities in supply voltage
Momentary drop in supply voltage



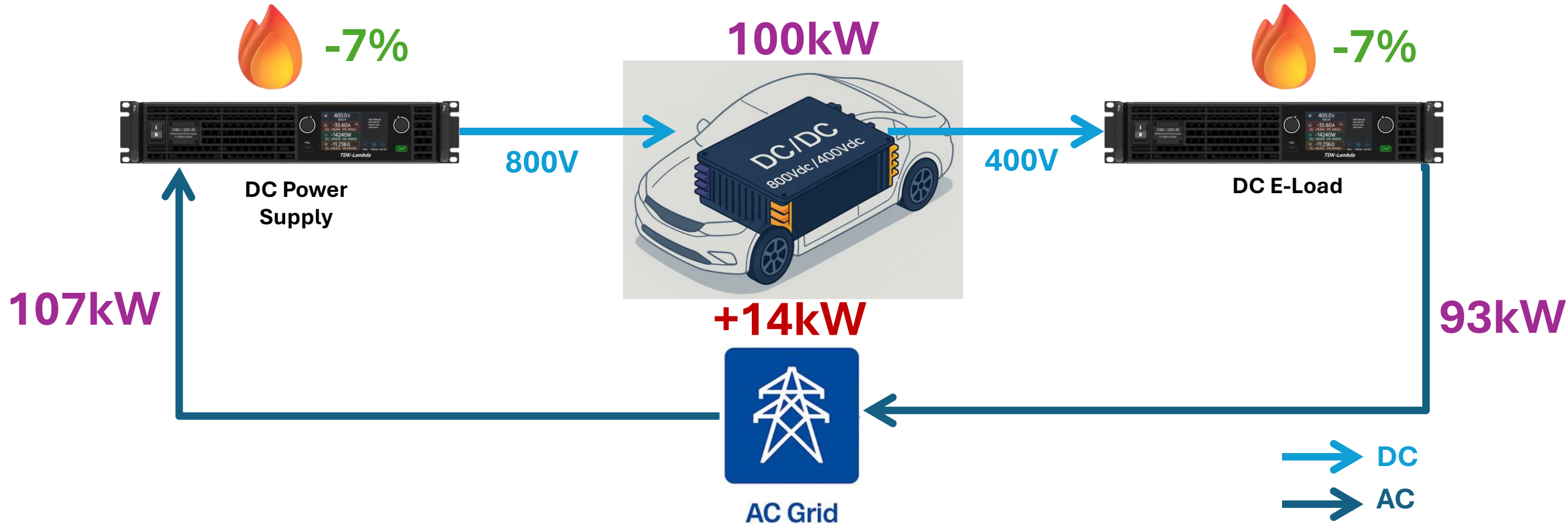
How a Bidirectional DC Power Supply Works

Inside a Bidirectional Power Supply: Energy Flow & Control



How a Bidirectional DC Power Supply Works

Inside a Bidirectional Power Supply: Energy Flow & Control



- Realistic EV testing without wasting energy (closed loop)

High Power Solution



48 units of G+ can be parallel together and
act as **1 system** (Master / Slave mode)

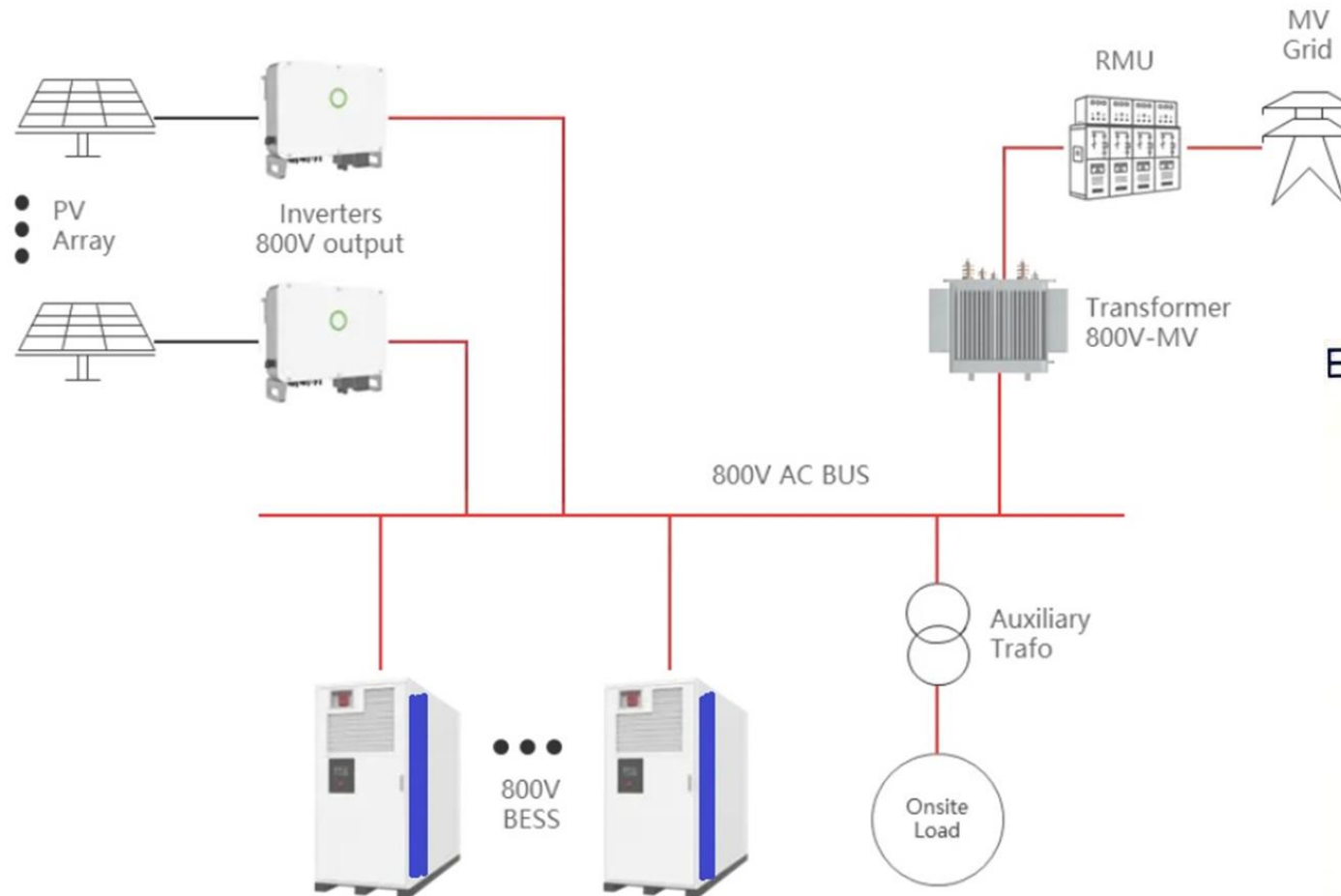
=> **Up to 360kw**

Realistic ESS (Energy Storage Systems)/ BESS (Battery Energy Storage Systems) Test & Validation

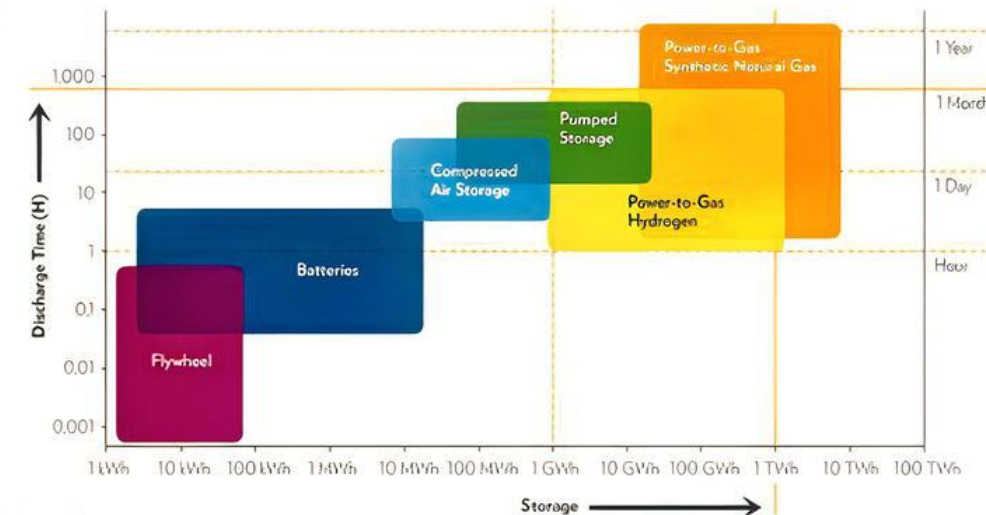
- ▶ Overview ESS and BESS
- ▶ Fast dynamic and pulsed load profiles
- ▶ Testing Equipment
- ▶ Safety, Compliance



Overview ESS and BESS



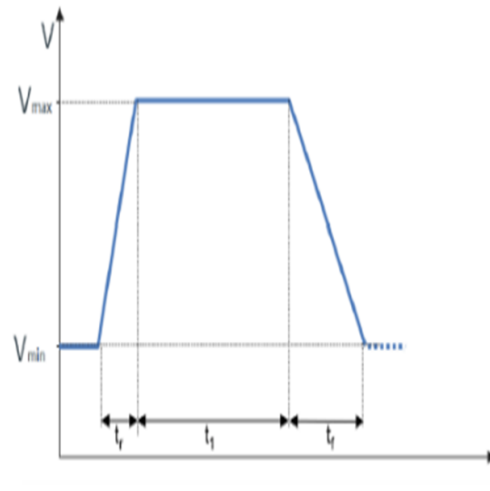
ENERGY STORAGE TECHNOLOGIES



Fast dynamic and pulsed load profiles

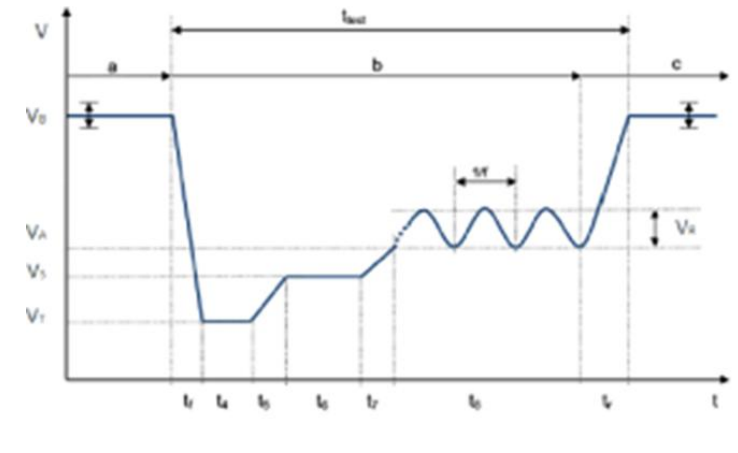
- ▶ Emulation: high slew rates, pulsed loads, step changes and simulated EV fast-charging transients
- ▶ Use cases: converter transient response, control-loop stability, protection and thermal cycling under pulsed stress
- ▶ Key specs: bandwidth, rise/fall time, control-loop update rate, pulsed power duration and duty cycle capability

DUT operating mode	Operating mode II.c
V_{min}	13,5 V
V_{max}	27 V (+4%, 0%)
t_r	≤ 2 ms
t_l	300 ms
t_f	≤ 30 ms
Break between cycles	1 min
Number of cycles	10
Number of DUTs	At least 6



Test case 1 – Cold start

Parameter	"Normal" test pulse	"Severe" test pulse
V_a	11,0 V	11,0 V
V_r	4,5 V (0%, -4%)	3,2 V $\pm 0,2$ V
V_s	4,5 V (0%, -4%)	5,0 V (0%, -4%)
V_A	6,5 V (0%, -4%)	6,0 V (0%, -4%)
V_D	2 V	2 V
t_r	≤ 1 ms	≤ 1 ms
t_A	0 ms	19 ms
t_D	0 ms	≤ 1 ms
t_S	19 ms	329 ms
t_r	50 ms	50 ms
t_D	10 s	10 s
t_r	100 ms	100 ms
f	2 Hz	2 Hz
Break between two cycles	2 s	2 s
Test cycles	10	10

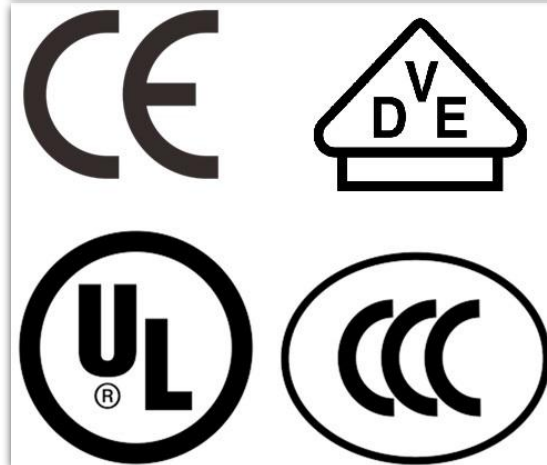


Testing

Safety



Standards



Functionality



Equipment & feature checklist

- ▶ **AC supplies:** multi-phase, low THD, independent phase control, programmable dips/harmonics, sync input/output, regenerative option
- ▶ **DC supplies:** bidirectional/regenerative, wide bandwidth, pulsed-power capability, programmable SoC emulation
- ▶ **Measurement & control:** high-accuracy power analyzers, scope channels, thermal sensors, CAN/Modbus/IEC-61850 interfaces
- ▶ **Safety:** interlocks, fast disconnects, overcurrent/OV/UV protection, automated shutdown on anomaly



Condition Group - Test Conditions	
Test Item	Test
Operator	
Time Test Started	10:00:00 AM
Time Test Completed	10:00:00 AM
Test Date	
Adjusted Temperature	
Relative Humidity	
Pressure	
Altitude	
Operator Comments	
Operator Observations	

Short Interruption - Additional Data	
Minimum Voltage (V)	0.000

Short Interruption - Test Condition	
Test Summary Editor	Test Summary Editor

Short Interruption - Parameters Table			
Seq	Value (V)	Duration (s)	Delay (s)
1	0.000	1	0
2	0.000	1	0
3	0.000	1	0
4	0.000	1	0
5	0.000	1	0

Short Interruption - Additional Data	
Minimum Voltage (V)	0.000

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3	0.000	1	0
4	0.000	1	0
5	0.000	1	0

This report is generated by TDK-Lambda VSC Virtual Control Panel v2.2.0.0.
The Lambda Co. will not be responsible for the data related anomaly to the operator.

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Safety compliance testing

- ▶ Typical targets: anti-islanding, LVRT/HVRT, reactive power capability, harmonic limits, ride-through
- ▶ Integration with test automation to run standardized test sequences and generate compliance reports



Standard	Version
IEC61000-4-11	Edition 3.0 2020-01
IEC61000-4-13	Edition 1.2 2015-12
IEC61000-4-14	Edition 1.2 2009-08
IEC61000-4-17	Edition 1.2 2009-01
IEC61000-4-27	Edition 1.1 2009-04
IEC61000-4-28	Edition 1.2 2009-04
IEC61000-4-29	First edition 2000-08
IEC61000-4-34	Edition 3.0 2020-01
RTCO/DO-160	RTCA DO-160G, December 8,2010
A350	AIRBUS - A350, ABD100.1.8.1 Issue C, 8 July,2008
MIL-STD-704	MIL-STD-704A
	MIL-STD-704B
	MIL-STD-704C
	MIL-STD-704D
	MIL-STD-704E
	MIL-STD-704F
MIL-STD-1399	MIL-STD-1399,SECTION 300, PART 1

Questions + Demo

- Visit the BMF System Parts Table for Questions and live demo



<https://www.bmf-systemparts.com/>

<https://www.emea.lambda.tdk.com/nl>

PE&ES event 2026

Power Electronics & Energy Storage
NextGen: Design & Engineering
Een FHI-event
27 mei 2026 | Congrescentrum 1931

Exposanten

1. BMF System parts
2. CN Rood (**DEMO**)
3. Heynen
4. AtrolKWX
5. Elincom
6. E-TOTAAL
7. Dewetron Benelux (**DEMO**)
8. Exide
9. TTMS (**DEMO**)
10. Haagse Hogeschool
11. TU Twente
12. TU Eindhoven
13. Electrometric
14. Chroma ATE Europe (**DEMO**)
15. Texim Europe
16. ELINEX Power Solutions
17. Phoenix Contact
18. MyBusinessMedia
19. Würth (**DEMO**)
20. Wefabricate
21. Telerex
22. Thal Technologies
23. Nijkerk Electronics
24. Hyteps
25. Acal BFI (**DEMO**)