BDF DIGITAL
TDE MACNO EES

SOLUTIONS FOR
ENERGY POWER CONVERSION

EMPOWER YOUR FUTURE
WITH SUSTAINABLE ENERGY

WIND POWER

HYDROELECTRIC POWER

STORAGE/BESS

HYDROGEN

MICROGRID

ABOUT US

BDF Digital is a 100% Italian company, with an ancient heart and rich in tradition.

Over 50 years of innovation and research in the world of industrial automation with brands recognised all over the world: TDE Macno (1976) and **ECS** (1970)**.**

Today, thanks to the merger of the two historical Italian companies, TDE Macno, based in Vicenza, and ECS, based in Florence and Milan, BDF Digital is a point of reference on the market for the **world of industrial automation** and **renewable energy.**

Thanks to the company's different yet complementary divisions, we design, develop, manufacture and market **servo drives, numerical controls (CNCs) and complete systems** capable of meeting the customer's specific needs in the field of industrial automation and renewable energy, while focusing on the simplification of processes and sustainability.

- **We make** our know-how available to create quality and long-lasting partnerships.
- **We support** our customers from pre-sales through to after-sales and, on request, provide highly customised solutions tailored to the real and specific needs of our customers.
- **We ensure** maximum energy efficiency, in industrial plants and renewable energies, to meet tomorrow's challenges, which are increasingly digital, green and sustainable.
- **We offer** our high-tech contribution to those who want to build value and industrial innovation.

ENERGY DIVISION

On the back of our extensive experience in the design of power electronics for the control of electric motors, industrial systems and static energy conversion, BDF Digital has developed innovative solutions for the world of renewable energy, creating the Energy Division.

The first regenerative converter (AFE - Active Front End) for energy recovery on industrial machines dates back to 1995.

Renewable energy sources currently account for a large part of electricity consumption, but the need is to move towards a distributed energy model, based on energy efficiency, savings, self-production and energy exchange: these are the challenges of the future, which will become increasingly digital, green and sustainable.

A 100% renewable future is not a utopia but a great opportunity and, thanks to its know-how, BDF Digital is able to respond to these needs by offering multiple solutions. We design and manufacture static energy converters, supply electrical panels and complete plant control systems.

We offer customised solutions, ensuring the following advantages:

- GREAT VERSATILITY
- MAXIMUM ENERGY EFFICIENCY
- GUARANTEED ENERGY SAVING
- CONSUMPTION OPTIMISATION

WIND POWER

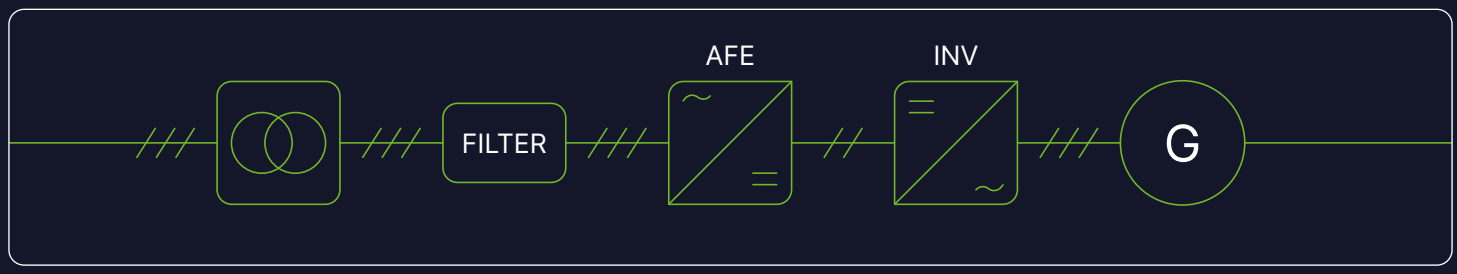
HYDROELECTRIC POWER

HYDROGEN

STORAGE/BESS

MICROGRID

SOLUTIONS FOR ENERGY FROM ROTATING MACHINES



Wind power

Wind power is a clean, cheap, inexhaustible source of energy that relies on harnessing air currents to generate kinetic energy and transform it into electrical power.

Hydroelectric power

Hydroelectric power is a great, highly efficient and environmentally friendly resource.

Performance, reliability and the best cost/revenue ratio are the Key Points that BDF Digital has set out for itself in recent years. Our plants work by maximising energy production and reducing maintenance time and costs as much as possible.

HIGH EFFICIENCY THANKS TO THE USE OF THE LATEST GENERATION IGBT.

USE OF FILM CAPACITORS **FOR LONGER SERVICE LIFE**.

ABILITY TO OPERATE THE ROTATING MACHINE AS A **GENERATOR** OR AS A **MOTOR**.

BDF Digital's solutions are specifically designed to connect variable speed renewable energy generation systems to the grid using permanent magnet synchronous, asynchronous or reluctance generators.

BDF Digital's solutions for converting the power from rotating machines consist of a motor/generator control inverter (PMSM, IM, SynRM) combined with the DC Link of an Active Front End (AFE). More specifically, BDF Digital's system consists of an indoor or outdoor dual inverter (back-to-back) panel.
When the kinetic energy generated by the wind or hydroelectric power system exceeds the pre-set limits, the generator delivers energy to the inverter, which converts it by charging the DC bus. This energy is in turn transferred to the grid by the AFE Energy via a suitable LCL filter, which guarantees low harmonic content (low THD values) and a unity or adjustable power factor.

Energy Storage System (ESS)

As a **system integrator**, BDF Digital offers the **ESS** (Energy Storage System) range, ideal for **managing**, **converting** and **using electrical energy** or energy from renewable sources (solar, hydro, wind, hydrogen) and for **charging external batteries** (lithium, sodium, etc.). In the long run, the use of these systems ensures **economic** and management **benefits** through their backup, **self-consumption optimisation** and **grid stabilisation** functions.

BDF Digital's solution is modular and has a two-part container structure:

PCS = STATIC ENERGY CONVERSION.
AFE ACTIVE FRONT END + DC/DC.

CONTROL ROOM WHERE THE OPERATOR MANAGES THE PLAN VIA A DEDICATED PLC.

Main features:

- **OUTDOOR INSTALLATION IN A CONTAINER** (SUBURBS, INDUSTRIAL AREAS, AIRPORTS).
- MODULAR POWERS: **FROM 500 KW TO 10 MW**.
- POSSIBILITY OF CONNECTING, **MULTIPLE SYSTEMS** IN PARALLEL.
- **VERSATILITY** IN DIFFERENT APPLICATIONS.
- **INTEGRATED EMS** (ENERGY MANAGEMENT SYSTEM).
- **MANAGEMENT OF SEVERAL TYPES OF BATTERIES:** LITHIUM, SODIUM, ETC.
- **PEAK SHAVING** TO REDUCE ENERGY CONSUMPTION PEAKS DURING PEAK PERIODS.
- **TIME SHIFTING** TO STORE ENERGY WHILE IT IS BEING OVERPRODUCED AND USE IT AT A LATER DATE.

Certifications:

- CEI 0-16
- CEI 0-21

Microgrid

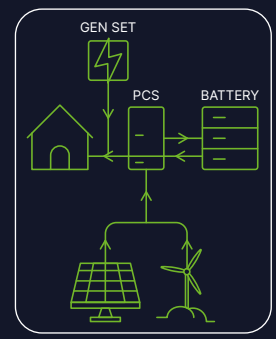
Through its R&D department, BDF Digital can offer stand-alone solutions – Off-grid, On-grid, with AC voltage and with frequency settable by the user.

Control mode:

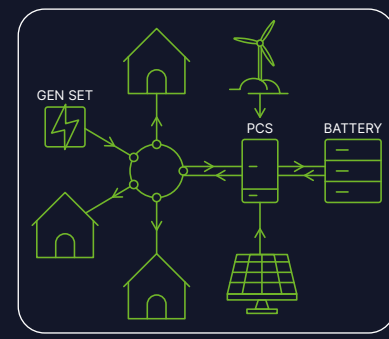
1. **GRID CONNECTED:** the power converter regulates the DC link and keeps the AC voltage and current synchronised, with the possibility of varying P&Q (cosϕ).

2. **MICROGRID:** in this operating mode, the converter operates in parallel with an existing AC grid, regulating the active and reactive current (power) fed into or drawn from the grid (**Grid Following**). 'Grid-parallel' operation can be achieved either by exploiting the droop control or certain peculiarities built into the control algorithm.
   The control incorporates a step machine that can autonomously manage the connection/disconnection to the AC source or the switch from microgrid to stand-alone operation **(Grid forming mode)** in the event of a blackout on the AC side and/or via fieldbus activation.

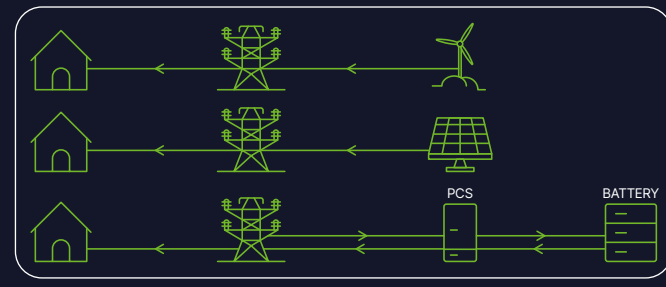
- OFF GRID/MICROGRID
- GRID FORMING AND FOLLOWING
- BLACK START
- RAMP RATE CONTROL
- POWER FACTOR CORRECTION
- LOAD E PEAK SHAVING
- ON GRID/ GRID SERVICES
- VOLTAGE CONTROL AND DROOP
- POWER FACTOR CONTROL
- REACTIVE POWER (VAR)
- FREQUENCY REGULATION
- PEAK SHAVING
- LOAD SHIFITING
- BLACK START E UPS
- ACCURATE AND FAST RAMP RATE CONTROL



HYBRID GRID



HYBRID GRID



FORMING (WITHOUT GRID)

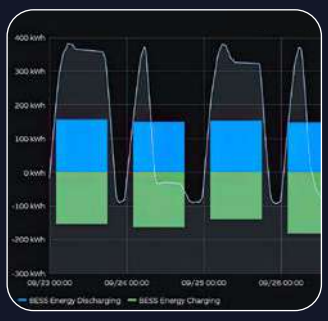
Energy Management System (EMS)

BDF Digital's EMS manages power flows across your production site, optimising energy costs through control strategies that reduce peak power consumption and maximise self- consumption.

It interacts, in real time, with the **PCS** (Power Conversion System) and the **BMS** (Battery Management System), collecting data from the **grid and load power** meters, and manages any alarms, air conditioners, fire systems and more. By integrating with Cloud/Edge, EMS **provides a two-way data flow that collects, analyses and stores energy information**. It is also able to adapt to varying energy requirements and supports different sizes of integrated systems, ranging from 30kW to 10MW.

POWER MANAGEMENT SCREEN


ENERGY PRODUCTION TREND


BATTERY USAGE TREND

Main features:

PEAK SHAVING, LOAD SHIFTING, CONTROLLO CARICHI.
IMPROVE ENERGY DISTRIBUTION BY SHIFTING CONSUMPTION PEAKS AND MANAGING LOADS EFFICIENTLY.

OPTIMISATION OF BATTERY CHARGING/DISCHARGING.
THE CONTROL STRATEGY HAS A SIGNIFICANT IMPACT ON THE RATE OF BATTERY DEGRADATION.

ADVANCED VISUALIZATION. ENHANCEMENT OF THE USER'S VISUAL EXPERIENCE BY SHOWING REAL-TIME POWER CONSUMPTION AND PRODUCTION, PROVIDING A COMPLETE OPERATIONAL OVERVIEW OF THE SYSTEM.

Power Conversion System (PCS)

BDF Digital designs and manufactures a complete range of PCS (Power Conversion Systems) and ESS (Energy Storage Systems).

These systems are critical to achieving the goal of a **smarter**, **more flexible grid** and optimal and efficient use of energy sources.
BDF Digital's PCS are also designed to operate in **parallel with the grid** or in **off-grid mode**, performing multiple functions with the aim of **improving** the availability and **quality of the power supply**, **reducing the cost** of energy supply.

Main features:

PEAK-SHAVING E LOAD LEVELLING
TO OPTIMISE POWER DISTRIBUTION.

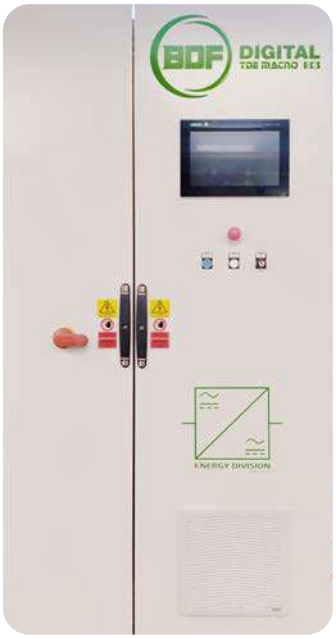
FREQUENCY ADJUSTMENT
TO ENSURE CONSTANT GRID STABILITY.

POWER SUPPLY IN CASE OF MAIN FAILURE
TO ENSURE QUALITY OF SERVICE.

ACTIVE AND REACTIVE POWER MANAGEMENT
TO MAXIMISE ENERGY EFFICIENCY.

CONNECTION AND INTEGRATION
WITH RENEWABLE AND NON-RENEWABLE ENERGY SOURCES.

BDF Digital's off-grid systems are ideal in settings with weak or absent grids, ensuring **high-quality continuity of electrical service.** In addition, we offer complete systems where the main source of energy supply and back-up are diesel generators, thus reducing fuel consumption and improving the quality and stability of power supply.



The ALL-IN-ONE STORAGE solution

BDF Digital's STORAGE is a complete ALL-IN-ONE system consisting of: **inverter**, **batteries** (lithium, sodium, etc.), **BMS** (Battery Management System) and **energy management system**.

- COMPACT SIZE
- MODULAR SOLUTIONS
- VARIABLE POWER RANGES

AFEPlus Energy

The AFEPlus Energy unit is designed to deliver exceptional energy savings in any application where energy needs to be returned to the grid.The AFEPlus Energy is a product that offers solutions for sizes from a few kW up to several MW, with voltages from 400 VAC to 690 VAC.

The Active Front End (AFEPlus Energy) is a **controllable rectifier** with several advantages, including the bidirectional exchange of energy between DC and AC power via DC Bus voltage control. With an intelligent conversion system based on IGBT technology, the AFEPlus Energy provides a **power exchange** with the active power line only (cosΦ close to one) while maintaining sinusoidal line currents. The active front-end is used to **return excess energy to the grid** and also to **reduce harmonics** in the grid current.

BDF Digital offers a wide range of Active Front End (AFEPlus Energy) inverter solutions for renewable energy applications in the fields of hydroelectric power, wind power and storage (BESS battery energy storage).

Type of user:

- SOLAR AND WIND FARMS
- ENERGY PRODUCERS
- DISTRIBUTION AND TRANSMISSION SYSTEMS
- SMART MICROGRIDS

Advantages:

MAXIMUM EFFICIENCY

EFFECTIVE AND SMOOTH INTEGRATION OF **RENEWABLE SOURCES**.

EXCHANGE WITH THE GRID OF **ACTIVE POWER ONLY**.
NO EXCHANGE OF REACTIVE COMPONENTS.

SINUSOIDAL LINE CURRENTS.
LOW HARMONIC CONTENT, THD ≤3%.

POSSIBILITY OF COMPENSATING **INDUCTIVE LOADS** OR **CAPACITIVE LOADS**.

TAILOR-MADE SOLUTIONS TO MEET SPECIFIC CUSTOMER REQUIREMENTS.

HIGH RELIABILITY EVEN UNDER HARSH WORKING CONDITIONS.

	XL			BF1				BF2			BF3		
Model @400 Vac	**40**	**48**	**60**	**70**	**90**	**110**	**150**	**175**	**220**	**250**	**310**	**370**	**460**
In @ Light Overload 120% x 30 sec. (Arms)	47,4	54,5	68,1	79,3	103	118,4	165,8	195,4	248,6	281,8	348,2	414,4	522,4
In @ Standard Overload 150% x 30 sec. (Arms)	42,2	48,5	60,6	70,6	91,7	105,4	147,6	173,9	221,3	250,9	310	368,9	465
Maximum Output Continuous Current (kW)	33	38	47	55	71	82	115	135	153	153	241	287	307

* For larger size applications, BDF Digital offers the power structure solution with the AFEPlus Energy BF3 in parallel with the central control unit.

OPDEPlus
Active Harmonic Filter (AHF)

What is harmonic distortion?

Harmonics are voltages and currents integrating frequency components that pollute the pure sinusoidal waveform in an AC circuit, ultimately distorting the main voltage. Harmonic interference reduces reliability, increases costs and affects the overall quality of the product. With BDF Digital solutions, **the influence of harmonics can be mitigated**, ensuring that the system operates as efficiently as possible.

How does the OPDEPlus AHF active filter work?

The active filter detects the harmonics present on the power supply line and generates waveforms antagonistic to the harmonics to be cancelled.
BDF Digital's OPDEPlus AHF filters can be **easily integrated in existing installations**, delivered pre-configured and adjusted directly on site: **ready to use**. This simplifies commissioning and significantly reduces installation time.

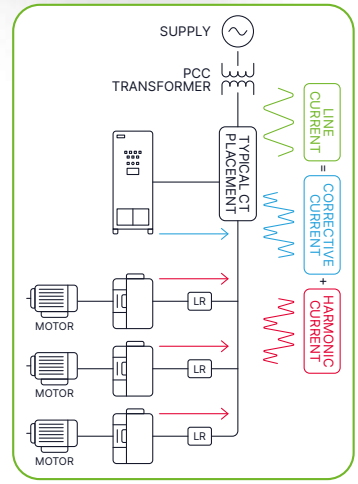
Easy to parameterise via PC software, RS485 or fieldbus (Profinet, EtherCAT, CANbus, etc.), the OPDEPlus AHF is **versatile** as it can address 3 power quality issues: **focus on current harmonic mitigation**, **load sharing**, **power factor correction** or **all 3 simultaneously**.

Technical data:

- MAIN VOLTAGE (L1, L2, L3) VOLTAGE RANGE **3 X 380-480 V AC**.
- CURRENT RATINGS SIXES XL (40-48-60A), BF1-BF2-BF3 (FROM 70 TO 510A).
- SUPPLY FREQUENCY **50/60 HZ ±2%**.
- COMPENSATION HARMONIC MITIGATION 2ND TO 17TH ORDER (WITH PWM STANDARD) OR HARMONIC MITIGATION 2ND TO 60TH WITH PWM 60 KHZ WITH IGBT WITH SiC TECHNOLOGY.
- **POWER FACTOR CORRECTION**, IMBALANCE COMPENSATION.

Application areas:

- WATER/WASTEWATER TREATMENT
- MARINE SECTOR
- OIL/GAS/MINING INDUSTRIES
- HVACR
- AIRPORT
- HOSPITALS



PCC: POINT OF COMMON COUPLING
CT: CURRENT TRANSFORMER
LR: LINE REACTOR

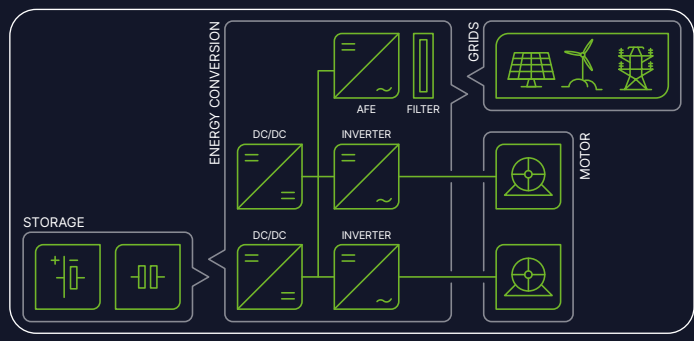
OPDEPlus DC/DC Power Converters

Optimises the benefits of solar/wind/hydroelectric power systems combined with a storage system with the OPDEPlus DC/DC converter.

- EASY TO INSTALL ANYWHERE AND COMPATIBLE WITH ALL BATTERY TECHNOLOGIES.
- IS CHARACTERISED BY THE ABILITY TO OPERATE IN BUCK MODE (TYPICALLY REQUIRED IN STORAGE SYSTEMS) AND/OR BOOST MODE.
- THE HIGH SWITCHING FREQUENCY DETERMINES THE SMALL SIZE OF THE LC FILTER LOCATED DOWNSTREAM OF THE CONVERTER.
- OPDEPlus DC/DC FACILITATES THE PARALLEL INSTALLATION OF STANDARD BDF DIGITAL CONVERTERS.

OPDEPlus DC/CD features and advantages:

- LOW CURRENT AND VOLTAGE RIPPLE, THANKS TO THE **HIGH SWITCHING FREQUENCY IN THE POWER UNIT**.
- **WIDE VOLTAGE RANGE, BIDIRECTIONAL OPERATION, FLEXIBLE INTEGRATION** IN THE INDUSTRIAL SECTOR THROUGH PROFINET, ETHERCAT, PROFIBUS COMMUNICATION NETWORKS.



FLEXIBLE INTEGRATION and a wide range of possible combinations.

Maximises the benefits of installations with our DC/DC:

1. With the coupled energy storage system in direct current, the excess energy, can be stored in the BESS and then delivered when needed.
2. The DC/DC mode allows stored energy to be supplied during periods of low power availability, achieving greater overall efficiency.

Automation

GLASS 

HVACR 

PACKAGING 

WOOD 

NAVAL 

PLASTICS 

PAPER 

METAL 

TEXTILE 

ROPE TRACTION SYSTEM 

TEST BENCHES 

Numerical Controls

MILLING 

CUTTING 

SHEET METAL BENDING 

MARBLE PROCESSING 

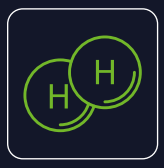
TURNING 

LASER CUTTING 

Energy

WIND POWER 

HYDROELECTRIC POWER 

HYDROGEN 

STORAGE/BESS 

MICROGRID 

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