

GE
Power Conversion

MV6 Medium Voltage Drive

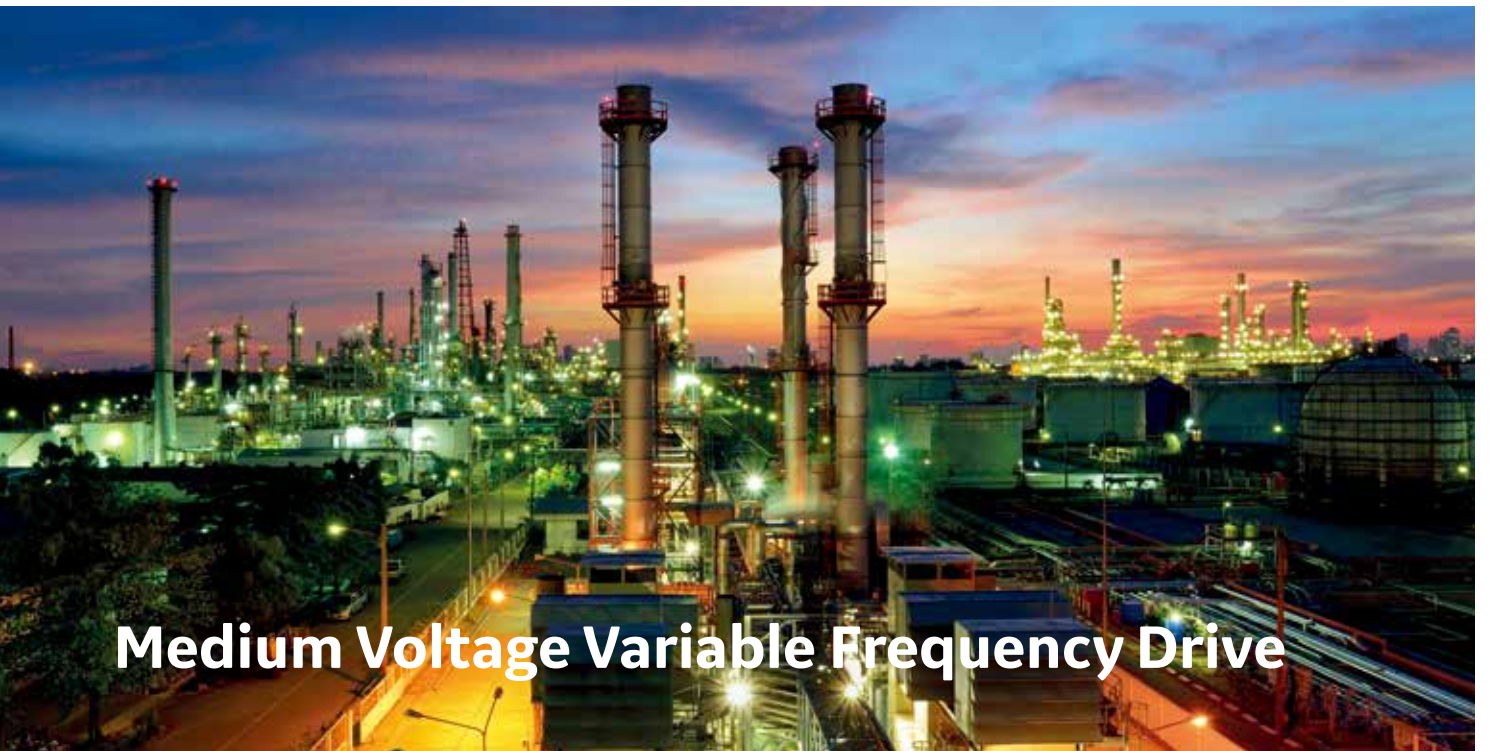
Leading next generation technology

High density, fault tolerant and versatile



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Medium Voltage Variable Frequency Drive

Medium voltage variable frequency drives (MV VFD) enable greatly improved efficiency, control accuracy and operational flexibility in your process. Compared with fixed speed operation and low voltage variable frequency drive, in more and more applications, MV VFD's has proven saving substantial capital and/or operational cost to end users, as standalone drives or as part of complex system solutions.

Simple & efficient control of your process

Variable frequency drives (VFDs) regulate motor speed to control the flow and pressure of blowers or pumps without dampers or throttling valves.

This results in energy savings and minimizes output waste. VFDs also provide a soft start to motors, reducing stress on driven load and resulting in lower maintenance costs.

Appropriate power usage in response to load

A VFD manages power based on actual demand and uses only the energy required by the driven equipment to provide valuable energy savings.

Avoid peak demand charges

When starting large motors with VFDs, current inrush peaks are eliminated. The VFD gradually ramps the motor up to speed by varying output voltage, current and frequency for a soft start.

Variable frequency drives can be used in a variety of industries and applications

Industry sector	Applications
Petrochemicals, oil and gas	Pumps, compressors, soft starters, electrical submersible pumps, extruders, blowers, mixers
Water	Pumps, blowers, aerators
HVAC	Chillers, fans
Power generation	ID fans, FD fans, feed water pumps, transfer/booster pumps, conveyors, centrifuges, wind turbines
Cement and mining	Mills, crushers, pumps, fans, conveyors
Paper and pulp	Vacuum pumps, chippers, refiners
Metals	Fans, pumps

GE offers the MV6 series medium voltage variable frequency drive (MV VFD) that boasts highest power density in industry, unique robustness and fault tolerance capability, and best-in-class power quality and efficiency, achieved through GE's patented multi-level nested neutral-point-pilot (nested NPP) technology.

MV6 series VFD is one of the most versatile medium voltage drives on the market configurations that cover voltage range of 3.3 kV-6.9 kV and power range of 210kW – 6.6 MW. With GE's deep and extensive experience in general industry and mission critical applications. MV6 VFD can be configured as diode front end (DFE) with integral transformer in two-quadrant operation, or re-generative active front end (AFE) with transformer in four-quadrant operation, or transformerless AFE using common set of building blocks. MV6 series VFD is suitable for world-wide applications and is certified to IEC 61800-3/4/5, IEEE 519, UL 347A, CSA C22.2, IEEE 693, GOST.

All MV6 series drives come equipped with Visor Connect – a remote monitoring system which connects the VFD to GE's global experts for real time service support when needed and helps prevent unscheduled downtime.

MV6 VFD Distinct Features

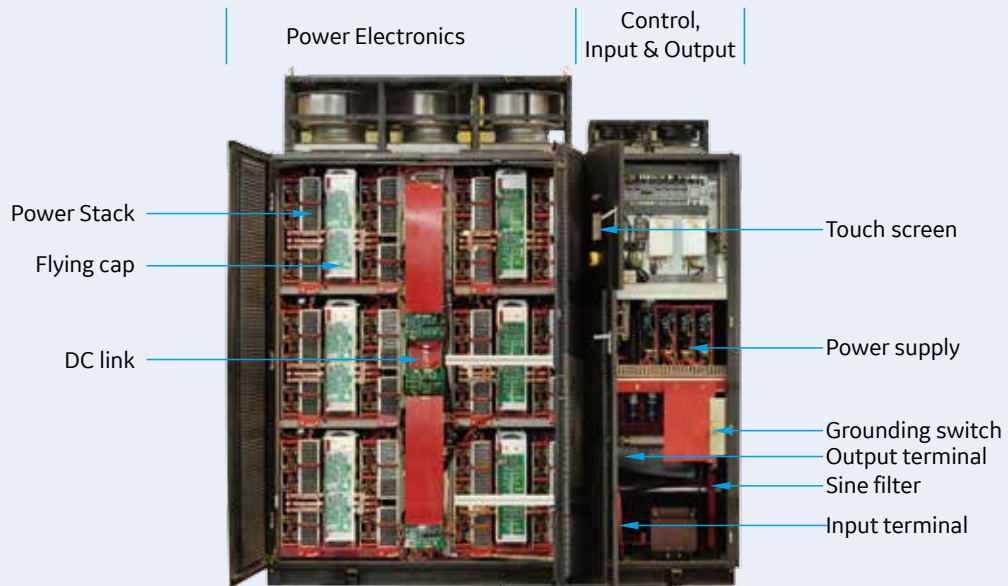
Innovative circuit leading next generation technology

MV6 adopts GE's patented and well-proven multi-level nested neutral-point-pilot (NPP) technology. To enable high power quality, and thus smaller filter, high density and high efficiency, multiple voltage levels are achieved by nesting two or more medium voltage 3-level NPP cells. For example, for 3.3kV – 6.9kV output voltage, 5-level phase voltage levels or 9-level phase-phase voltage levels are created with two 3-level medium voltage NPP cells in nested structure.

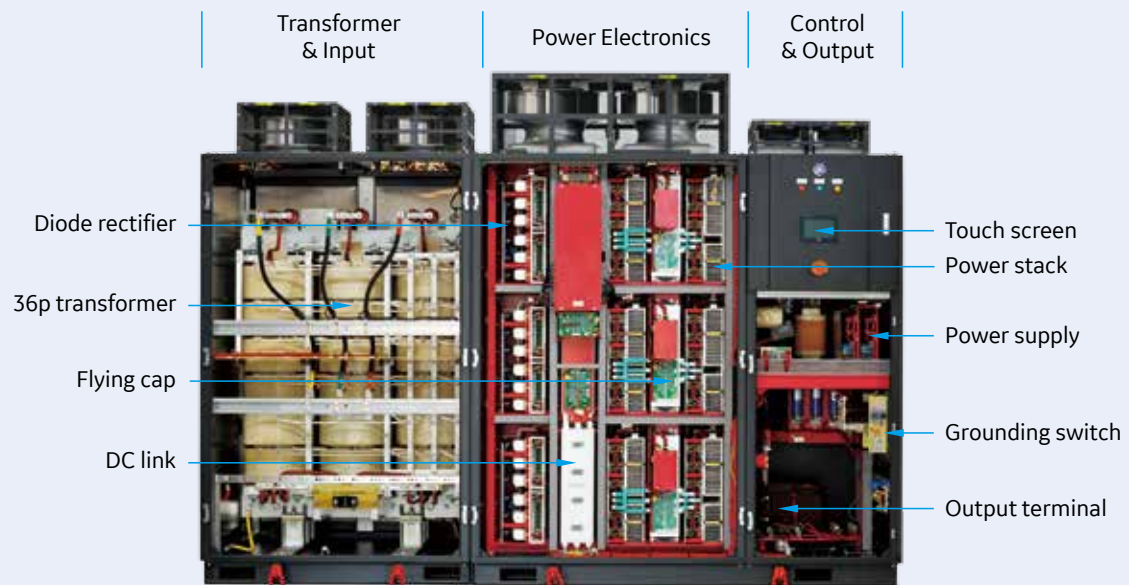
Nested NPP multi-level technology provides a single medium voltage common DC link that improves power density due to smaller DC link energy storage, allows a common DC bus configuration for multi-drives, and enables easier grounding scheme for safe operation.

Nested NPP technology is easily scalable in voltage range, output voltage levels, and drive configurations such as DFE, AFE, and transformerless AFE.

AFE



DFE



»» Bumpless Fault Tolerance at Power Device Level

With GE's smart gate drive and device serialization technology, MV6 practically eliminates the most common and dangerous failure mode of shoot-through. MV6 offers N+1 redundancy at power device level with bumpless fault tolerance feature as option. It has inherently built-in high voltage margin to ensure higher reliability and avoid voltage derating for high altitude applications.

»» Ease of System Integration and Grid Friendly

MV6 DFE provides an integral 36-pulse diode rectifier as standard offer. It can meet the most stringent grid harmonic requirements around the world. No additional system study is needed to integrate MV6 DFE in customer's power system. MV6 AFE and transformerless AFE offer unity power factor with low input current harmonics.

»» Modern Industry Design for Safety and Style

MV6 design highlights customer and operational safety. It comes with arc-resistance capability, tested and certified by third party lab, as a standard offer. The unique and stylish industry design features reinforced enclosure, arc resistant door and panel structure, and pressure relief flaps to ensure safe operation in the unlikely event of arc flash hazards. It also features an LED illuminated strip indicating operation modes that allows users to easily tell if hazardous medium voltage levels are present inside the cabinet.

Ease of Integration with eHouse

»» MV6 series VFD can be easily integrated into a prefabricated e-House together with other electrical equipment, such as switchgear. Due to its high power density and high efficiency, MV6 series VFD is particularly suited for applications where indoor space is limited. For air-cooled MV6, heat rejected from the VFD may be removed by air conditioner or air-to-air heat exchangers. GE offers complete engineering solutions with specialized knowledge and wide experience.



Standby



Energized



Warning



»»» Friendly User Interface and Rich Control Features

An easy to use LCD touch screen is provided as standard offer for operations featured with:

- Password protected access
- Local command setting and operation button
- Power flow live mimic
- Signal trend record
- Fault history
- Multi – language support

Flying start into a spinning load

The MV6 offers the ability to catch and take control of a spinning load without any damaging torque, voltage or current impacting the equipment if started while the load is already spinning.

Critical speed avoidance

The MV6 can be programmed for up to three critical frequency bands and ride-through these without any resonance issues.



Visor Remote Monitoring & Diagnostics

DELIVERING VALUE WITH REMOTE MONITORING & DIAGNOSTICS

GE Power Conversions Visor solution allows for real time remote monitoring of assets by GE experts based anywhere in the world allowing for an increased response time when it is needed the most.

The embedded Data Historian enables access to historical data for advanced trending and data mining with the ability to provide automatic alerts* when alarm or fault occur on the drive.

We believe data driven decisions are key, that's why we provide monthly/ quarterly health reports* created from the data collected within Visor by trained experts.



VISOR CONNECT BOX (VCB)

The compact Visor Box is the physical hardware that is installed at your site to monitor control system devices. It hosts integrated Data Historian and Engineering servers that provide a repository for control system data as well as project and engineering information. GE Engineers can access all of this information remotely via a secure site connection.

Our system security follows best practices, including the use of hardware firewalls to create a demilitarized zone (DMZ) to isolate the control networks from external networks. The DMZ architecture is tested and certified to Wurdtech Achilles Level 1.

KEY BENEFITS

- Support from Remote Experts
- Remote Assistance with Spare Parts Management
- Enhanced Upgrade Support
- Availability of Remote Training
- Enhanced Remote Technical Support & Engineering
- Service Agreement Specific Features:
 - Monthly/ Quarterly Health Reports
 - Automatic Fault Notifications/ Incident Detection
 - Dashboards

KEY INDUSTRIES & APPLICATIONS

Oil & Gas, Industry, Marine, Naval, Mining, Power and Renewables

BASIC FEATURES

- *Worldwide remote service support*
- *Automatic Alerts for Drives*
- *Data Historian*
- *Reduced response time*
- *Fast tag processing >250,000 tags/s*
- *Single, onsite software repository*
- *Third-party data logging supported*
- *On-Prem Support for Embedding GE's Digital Solutions*
- *Switchable Read/Write, Added Security/Functionality*

AVAILABLE CONFIGURATIONS

- **Read-Only Visor** - This default variant allows GE experts remote viewing of application software and extraction of files. To comply with some industry practices, all remote access is read-only for Marine applications.
- **Dedicated Write-Enabled** - This variant is for customers who wish to conduct remote changes—when necessary and follow strict access protocols.
- **Visor Switchable Read/Write** - This variant allows you to enable write-enabled mode with the press of a button that is located on the hardware. By doing this, Visor offers the functionality and cost-reducing features.

* Available only with service agreements

MV6 Versatile Configurations

Diode Front End

With standard integral 36-pulse transformer and diode rectifier, MV6 DFE offers one of the highest power quality diode-front-end VFD on the market. The high power quality eliminates the need for grid studies even when applied to projects with most stringent grid code requirements, thus it greatly simplifies the effort for system integration. The flexibility of DFE solution allows MV6 to adapt to much wider range of grid voltage levels around the world, regardless of motor voltage level. The simplicity and low parts count of DFE solution provides high reliability. DFE solution is suited for two quadrant motoring operation.

- Integrated transformer simplifies installation and commissioning
- Flexible line side connection with wide choices of grid voltage levels – 3.3, 4.16, 6, 6.6, 6.9, 10, 11, 13.2, 13.8 kV
- 36-pulse rectifier provides very low harmonics that meets the most stringent grid code around the world
- Provides 0.96 power factor across speed range with 20-100% load. No power factor correction capacitor is needed.

Active Front End with Transformer

MV6 AFE provides four-quadrant operation capability required for applications where motoring and regenerative braking are needed. The active front end rectifier provides unity power factor and low input harmonics. It allows fast process dynamics and energy recovery during regenerative mode. MV6 AFE has a simple and elegant structure where the AFE rectifier simply is a mirror image of the inverter. It shares the same common set of building blocks, and thus simplifies spare parts, maintenance and service on projects for customers.

- Four-quadrant operation
 - Inherent braking capability to slow high inertia loads quickly, such as ID fans, without the needs of braking resistors
 - Excellent ability to overhaul loads such as downhill conveyors
 - Ability to recover energy by transmitting power back to grid, such as for marine Power Take-In/Power Take-out (PTI/PTO)
- Unity power factor across speed range. No power factor correction capacitor is required. Adjustable VARs can be

- supplied to the grid as an option
- Very low input harmonics

Transformerless Active Front End

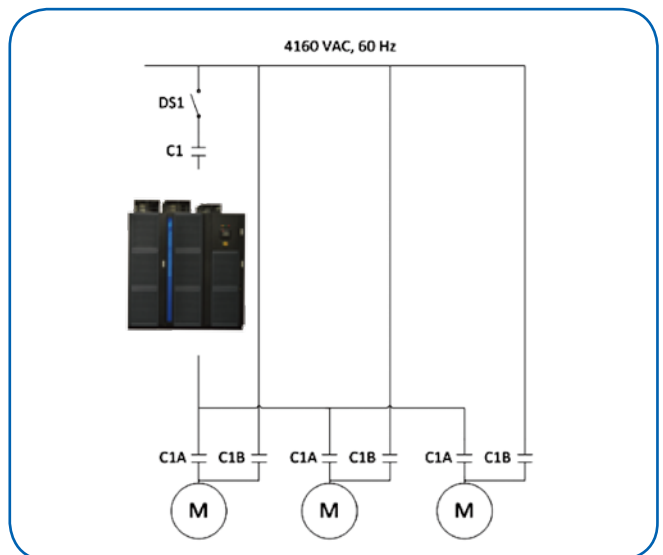
MV6 transformerless AFE boasts highest power density and efficiency. By eliminating the input transformer, MV6 transformerless AFE delivers best in industry power density and greater than 97.5% efficiency. This greatly reduces footprint for integration in eHouse, and requires less HVAC due to reduced heat loss. Due to its smaller size and reduced weight, transformerless AFE also reduces transportation cost.

- Highest power density - smaller, lighter
- Highest efficiency due to elimination of input transformer
- Reduced heat load, smaller space and less HVAC requirements in control room

One drive for multiple motors

- Lower capital cost
- Smaller installed footprint
- Less maintenance
- Reduced spare parts inventory

Cooling fan redundancy



MV6 can be configured with two modes of cooling fan redundancy: hot standby and cold standby. With hot standby mode, redundant fans work together with primary fans. No switchover needed and no risk of air flow interruption in case of single fan failures. With cold standby mode, redundant fan stands by at non-operation status. Fans automatically switch over once over temperature is detected or air pressure is lost.

Up and down synchronous transfer

- Start multiple motors one-by-one and transfer them to utility lines
- Run the last motor continuously on VFD at variable speed
- Increased energy savings

Available options

- Input/output disconnect switch

- 36 pulse transformer with copper winding for DFE
- Xfrmerless AFE
- Sine filter on the output side for long cable lengths
- N+1 redundancy options
- Redundant fan
- Automatic or manual by-pass
- Motor Protection Relay Multilin 469/369
- Motor heater power control
- VFD space heater
- IP 42 enclosure
- Other customized options

Customer Benefits

Quick & easy installation

- Plug & Play
- Top, bottom or both cable entry/exit
- Quick installation for lower cost of ownership
- Less process downtime for greater plant output

High availability

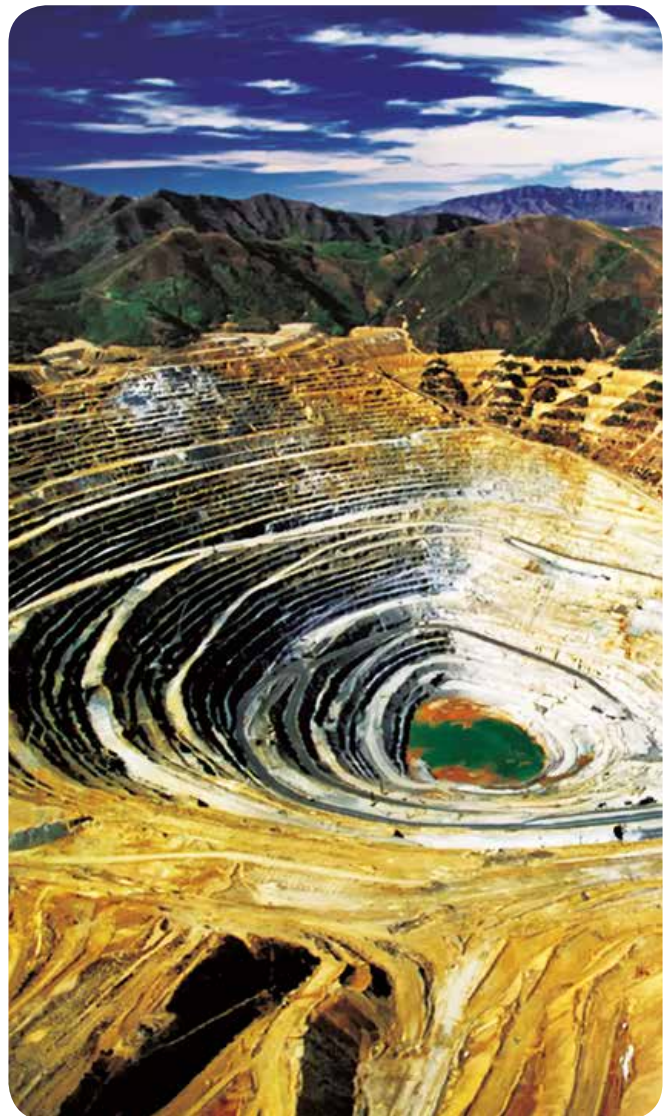
The MV6 Series utilizes rugged IGBT power modules that provide high reliability with a low life-cycle cost.

The modular design includes common power modules that are used for both DFE and AFE power circuits.

The standard power module reduces the overall MTTR and increases the availability of the drive. Each power module and power circuit is tested at full power prior to shipment from the factory.

High efficiency and low losses

The MV6 delivers higher efficiency. Low heat emissions reduce air-conditioning requirements in the control room and overall cost of ownership.

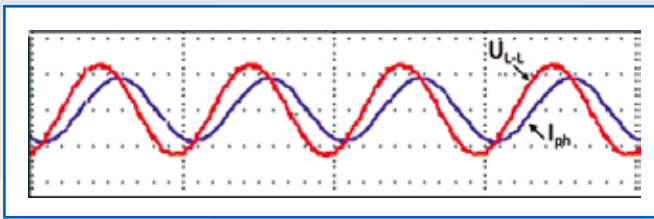


Power Quality Benefits

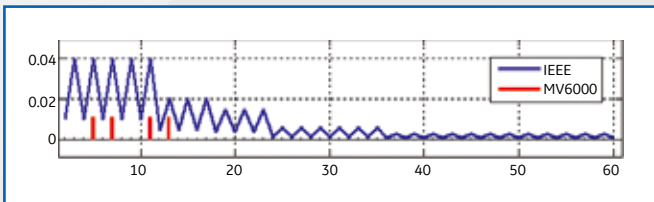
Power quality input

Using either the 36 pulse DFE or the AFE option, the MV6 Series meets the most stringent industry requirements for harmonic limits.

- Clean power input
- IEEE 519-1992 standard compliant
- No external filters
- No harmonic disturbance to other online equipment



Grid line voltage & phase current for DFE Drive



Current spectrum & standard

Input power factor

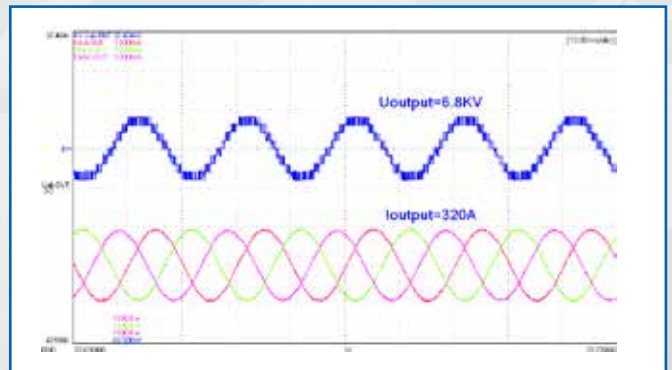
- 0.96 power factor DFE or unity (default) power factor AFE
- No need for power factor correction equipment
- With AFE, VARs can be supplied to utility lines as an option

Motor-friendly output - drive of choice for new & retrofit applications

- Multi-level PWM waveform-providing smooth output to the motor
- Low VFD-induced torque ripple

With output sinus filter

- No special motor insulation
- No motor de-rating
- Works with standard motors
- Good for new and retrofit applications



Voltage spectrum & standard with simple dv/dt filter

Process Control Benefits

Power dip ride-through

In the presence of insufficient input voltage, MV6 will provide kinetic support to hold the DC bus. MV6 series can ride through the input voltage dip down to 70% of rated without tripping.

Auto-restart function

MV6 series can provide auto-restart function for pump&fan load in the event of momentary loss of input power to improve customer side availability.

Independent acceleration and deceleration ramps

MV6 has independent acceleration and deceleration ramps tailored to customer process needs.

Ease of set-up & diagnostics

- Standard control interface offers digital inputs/outputs and analog inputs/outputs as standard. Each of these inputs/outputs can be programmed to a variety of different functions for flexibility.
- Touchscreen operator interface allows for quick, user-friendly programming. Screens for fault parameters and meters are user configurable.
- MV6 Series tool suite is designed to offer a full range of programming and monitoring tools. Operating data can be captured with a snapshot feature and drive signals can be trended. In addition, tool suite offers trace-back data for detailed fault analysis.

MV6 Drive Options

MV6 Series ratings

DFE

	VFD Model No	Motor shaft power kW*	Motor shaft power hp*	Output current A	Dimension
3.3kV	MV6303-13-AD	685	919	144	F2A
	MV6303-16-AD	825	1106	173	
	MV6303-19-AD	962	1290	202	
	MV6303-22-AD	1100	1475	230	F2B
	MV6303-24-AD	1237	1659	259	
	MV6303-27-AD	1375	1844	288	
	MV6303-29-AD	1470	1971	308	F3
	MV6303-30-AD	1575	2112	330	
	MV6303-33-AD	1670	2240	350	
	MV6303-35-AD	1810	2427	380	F4
	MV6303-37-AD	1835	2461	385	
	MV6303-44-AD	2205	2957	462	
	MV6303-48-AD	2385	3198	500	F5
	MV6303-52-AD	2570	3446	539	
	MV6303-55-AD	2765	3708	580	
MV6303-60-AD	3005	4030	630	F5	
MV6303-68-AD	3340	4479	700		
4.16kV	MV6401-03-AD	210	282	35	F1A
	MV6401-05-AD	345	463	58	
	MV6401-08-AD	510	684	86	
	MV6401-10-AD	690	925	115	
	MV6401-12-AD	780	1046	130	
	MV6403-13-AD	860	1153	144	F2A
	MV6403-16-AD	1040	1395	173	
	MV6403-19-AD	1200	1609	202	
	MV6403-22-AD	1380	1851	230	
	MV6403-24-AD	1550	2079	259	
	MV6403-27-AD	1700	2280	288	F2B
	MV6403-29-AD	1850	2481	308	
	MV6403-30-AD	1985	2662	330	F3
	MV6403-33-AD	2100	2816	350	
	MV6403-35-AD	2285	3064	380	
	MV6403-37-AD	2315	3104	385	F4
	MV6403-44-AD	2780	3728	462	
	MV6403-48-AD	3009	4035	500	
	MV6403-52-AD	3244	4350	539	F5
	MV6403-55-AD	3490	4680	580	
MV6403-60-AD	3790	5082	630		
MV6403-68-AD	4210	5646	700		
6.6kV	MV6601-03-AD	330	443	35	
	MV6601-05-AD	550	738	58	
	MV6601-08-AD	825	1106	86	
	MV6601-10-AD	1100	1475	115	F2A
	MV6603-13-AD	1375	1844	144	
	MV6603-16-AD	1650	2213	173	
	MV6603-19-AD	1925	2581	202	F2B
	MV6603-22-AD	2200	2950	230	
	MV6603-24-AD	2475	3319	259	
	MV6603-27-AD	2750	3688	288	F3
	MV6603-30-AD	3150	4224	330	
	MV6603-33-AD	3340	4479	350	
	MV6603-35-AD	3625	4861	380	F4
	MV6603-37-AD	3675	4928	385	
	MV6603-44-AD	4410	5914	462	
	MV6603-48-AD	4775	6403	500	F5
	MV6603-52-AD	5145	6900	539	
	MV6603-55-AD	5535	7423	580	
	MV6603-60-AD	6015	8066	630	
MV6603-68-AD	6680	8958	700		



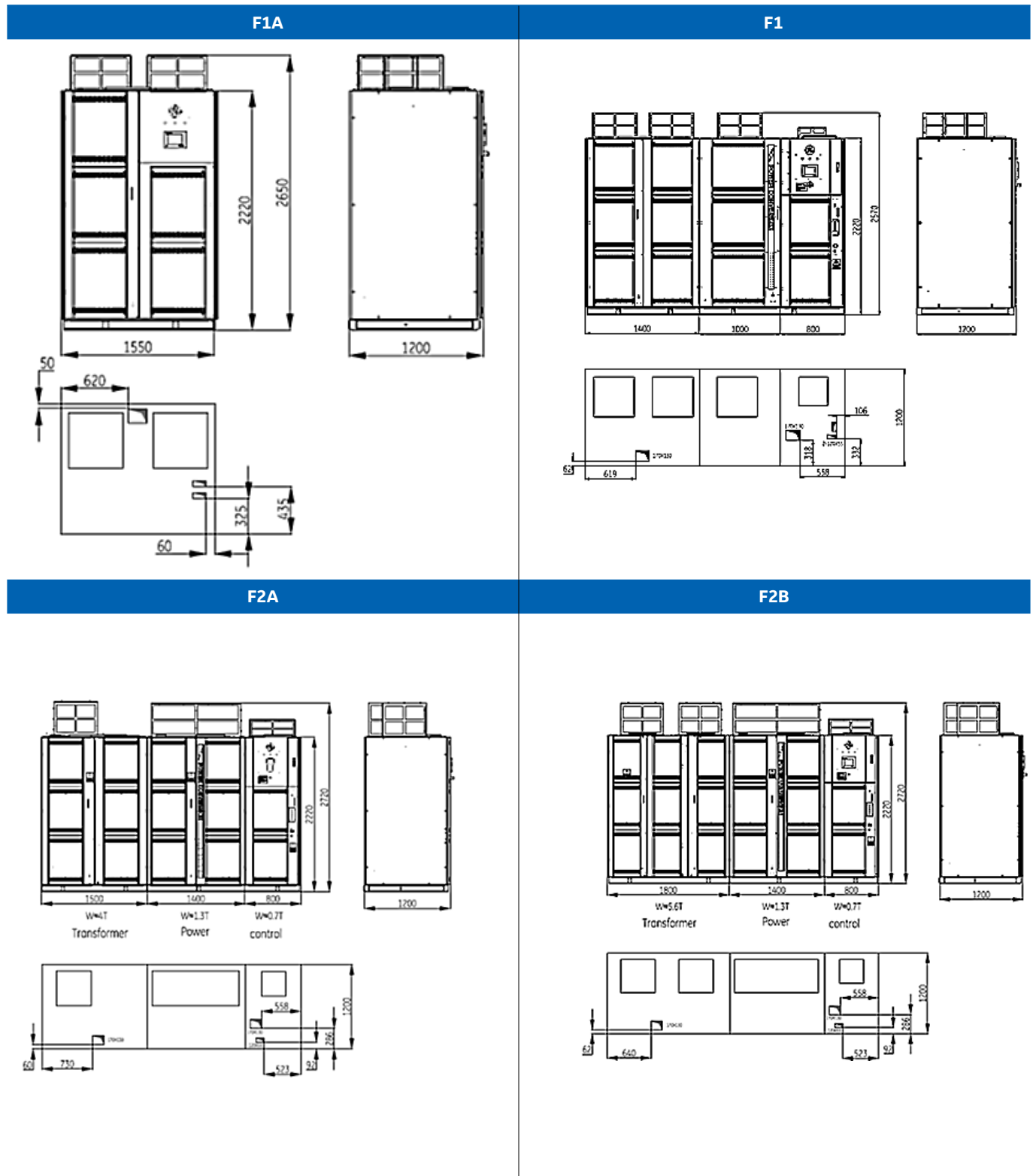
AFE

	VFD Model No	Motor shaft power kW*	Motor shaft power hp*	Output current A	Dimension#
4.16kV	MV6403-13-AA	860	1153	144	G2
	MV6403-16-AA	1040	1395	173	
	MV6403-19-AA	1200	1609	202	
	MV6403-22-AA	1380	1851	230	
	MV6403-24-AA	1550	2079	259	
	MV6403-27-AA	1700	2280	288	
	MV6403-29-AA	1850	2481	308	
6kV	MV6603-13-AA	1375	1844	144	G2
	MV6603-16-AA	1650	2213	173	
	MV6603-19-AA	1925	2581	202	
	MV6603-22-AA	2200	2950	230	
	MV6603-24-AA	2475	3319	259	
	MV6603-27-AA	2750	3688	288	

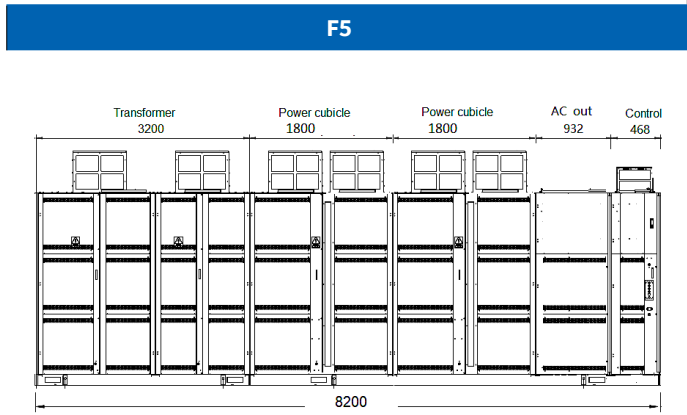
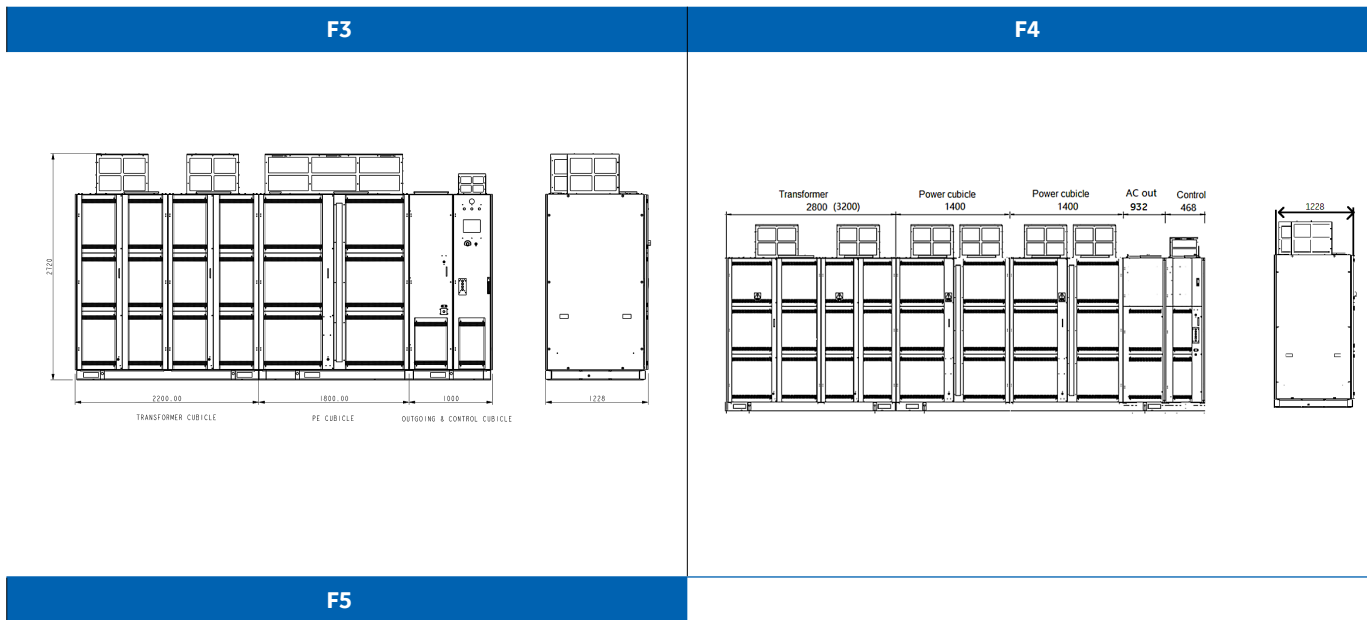
*Motor power considering 96% eff & 0.87pf. Standard OL of 110% for 1 min every 10mins
 #Dimension shown is for AFE Transformer-less model

Dimension

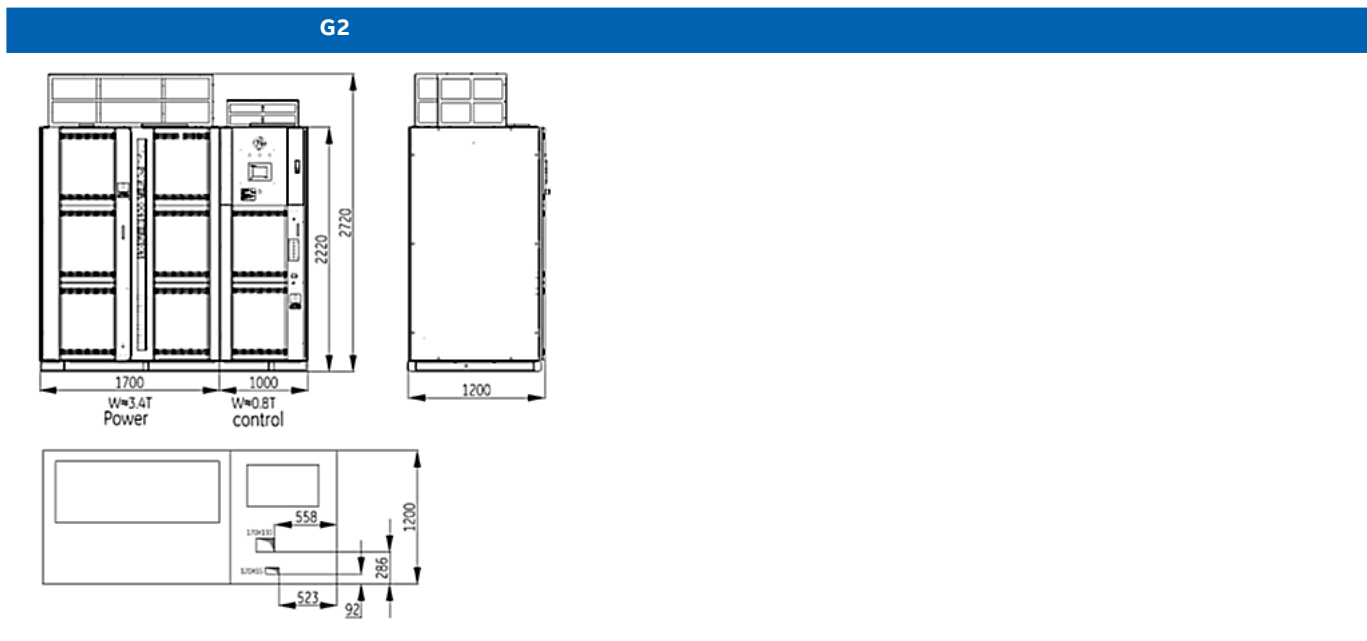
DFE



DFE



AFE



MV6 Drive Specifications

VFD Ratings	
Output power	210kW to 6680kW
Output voltage	3.3, 4.16, 6, 6.6, 6.9 kV
Output frequency	0 to 100Hz; higher on request
Input voltage	DFE: 3.3, 4.16, 6.0, 6.6, 6.9, 10.0, 11.0, 13.2, 13.8 kV AFE transformer-less: 4.16, 6.0 kV AFE with transformer: 3.3, 4.16, 6.0, 6.6, 6.9, 10.0, 11.0, 13.2, 13.8 kV
Input frequency	50 Hz; 60 Hz +/-5%
Auxiliary voltage	1 / 3 phase 120, 230 / 400, 460, 575 V +/- 10%
Power Quality	
Line side converter	36 pulse DFE or multi-level PWM AFE; IGBTs
Load side inverter	Multilevel PWM IGBTs
Typical VFD efficiency @rated	DFE: 96.5% including transformer / AFE: 97.5% AFE transformer-less
Power factor	DFE: 0.96 power factor with 20-100% load / AFE: 1.0 power factor
Input harmonics	IEEE 519: 2014 compliant
Energy Storage	
DC link	Self-healing, long life, medium voltage film capacitors
VFD Control	
Mode of operation	DFE: two-quadrant / AFE: four-quadrant
Mode of control	V/Hz; with sensor or sensor-less vector
Analog input / output	4-20 mA standard or +/-10 Vdc optional
Digital input / output	24 Vdc and relay
Speed regulation	+/- 0.5% without encoder; +/- 0.1% with encoder
Fieldbus communication interface	Modbus TCP as standard Optional: fieldbus protocol on request
Protective functions	Overcurrent; overvoltage; over temperature; loss of phase; loss of DC link; motor overload; motor stall and over-speed; auxiliary supply fault; breaker supervision; communication fault
Environment & Enclosure	
Enclosure	IP31, up to IP 42 as option, air-cooled, top and bottom cable entry
Ambient / elevation	0-40° C / 1,000 m above sea level; higher with de-rating
Cooling air quality	Pollution degree 2 per IEC 61800-5-1 and EN 50178
Industry Standards	
Standards	IEC 61800-3, 4 & 5; UL 347A; CSA C22.2; GB12668-3, 4 & 5



Services From GE - A Focus On Availability

We understand the vital importance of process availability | and our focus on service keeps us actively engaged, both when things are going right, and when they are going wrong.

Our world-class Global Customer Service and Support Center is available 24/7, 365 days a year. Our strategic distribution centers and authorized distributors carry an extensive inventory of GE's drives, allowing us to quickly fulfill your genuine replacement part needs, no matter where you are located.

With a comprehensive global network of service engineers and technicians, GE is uniquely positioned to provide the knowledge, experience and skills for your full range of industrial service requirements. From system design to maintenance and outage support, we have the resources and capabilities to advance your equipment's performance and reliability.

Some key benefits of GE's support are:

- Single point of contact
- Reduced call-out rates
- 24/7 availability
- Rapid mobilization of engineers
- Routine maintenance visits
- Training
- System health checks
- Spares management
- Obsolescence management

GE also provides managed system upgrade paths for our legacy systems and has significant experience in replacing systems from other manufacturers with low disruption to the existing infrastructure.

Remote support

Visor Connect, GE's remote diagnostic and support system, is based on highly secure satellite communications links.

It enables our experts, regardless of their geographical location, to look over the shoulder of your onsite equipment operator or technician and advise and assist you on fault finding and resolution.

GE
Power Conversion

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