BORNA DI MEDIUM VOLTAGE

Variable Frequency Drives (BORNA-MegaDrive)



TOTAL Y

BORNA Electronics



BORNA ELECTRONIC CO. has been established in 1986 and is active in manufacturing electrical & electronics equipment and industrial control. We are glad for nearly 3 decades of succeeding and being a leading company in industrial development aspects of IRAN. At the time being, this company produces various products in the following fields:

- Electronics protection, monitoring and timing relays
- DC/AC Drive (Motor Speed Controller and Soft Start)
- Cathodic protection equipment
- AC/DC power supply and industrial battery charger and UPS
- Industrial resistance (Earthing Resistance, Load Bank, MotorStart, resistance and Rheostat)
- SMD assembling line with SIMENS machinery

Solution Contraction

We have acquired ISO 9001-2008. Also, we have certification for management from DQS of GERMANY (ISO 9001-2008, ISO 14001-2009, OHSAS 18001-2007, IMS & HSE) for manufacturing and designing the above mentioned products.

V Our Guidelines

As a leading producer in electric equipments and industrial electronics, BORNA ELECTRONICS Company has some guidelines as following:

- Considering human resources and preparing the way for improvement.
- Promoting the quality of the products for more satisfaction of the customers.
- Designing new products according to customers' requirements.
- Developing local and foreign markets.
- Reducing the production costs and increasing the efficiency.
- Developing and improving organization processes for saving and promoting environment according to legal requirements and preventing from ecological pollutions.
- Improving work circumstances through proper recognition of safety risks and professional health services and preventive action, and through complete covering of related legal requirements.

A wide range of applications

In recent years, high energy consumption has constrained economic growth very badly with the enhancement of industrial GDP, therefore, the Government has invested much money to support energy saving and consumption. Medium voltage variable frequency drive technology has been widely used for speed regulation, energy saving, soil startup and intelligent control of the medium voltage motors in industries such as thermal power plant, petroleum, chemicals, mining and metallurgy. Borna Electronics Co. has manufactured Medium Voltage Variable Frequency Drive which is branded by BORNA-MegaDrive, based on near 30 years rich experiences in power electronics and relay protection. BORNA-MegaDrive can be widely applied to the following industries:



- pumps etc.
- Coalmine: belt conveyors, exhaust fans, etc.
- grinding machines, etc.
- and wind tunnel test.

• Power Generation: Induced draft fan, forced draft fan, condensate pump, feed pump, primary air fan, secondary air fan, booster fan, circulating pump, mill fan, slurry pump etc.

• The petroleum and gas industry: compressors, draught fans, transfer pumps etc.

• The metallurgy: blast furnace blowers, dust blowers, water pumps etc.

• The large water transport project: water intake pumps, water supply pumps, pressure

Cement: kiln head fans, kiln inlet fans, circulating fans, high-temperature fans, raw material

Others: Loads such as fans pumps and compressors in pharmaceutical, paper making

Technical Specifications

- BORNA-MegaDrive is a voltage source inverter which can realize a very smooth speed regulation for medium voltage motors. It makes typical motors into intelligent ones.
- BORNA-MegaDrive output voltage contains few harmonics which causes the motor not to generate extra heat and noise.
- Low harmonics and high power factor input, the typical value for power factor is 0.95 for loads more than %20, and there is no need for power factor correction.
- Modularized design of power units, interchangeable and easy to produce and repair, the capability of finding faults based on advanced diagnostic procedures in CPU
- BORNA-MegaDrive can operate even under the condition of fault occurrence for some parts of power units using bypass function.
- Applicable to all kinds of power grids and suitable for typical medium voltage motor.

- Colorful touch screen, easy to operate and maintenance.
- Able to realize remote control, DCS operation and communications with Host, and support all kinds of communication interfaces such as CAN, Profibus, Modbus, RS232, RS485 etc.
- Using the most advanced components, master control chip adopted TI's DSP F28335 and ALTERA's FPGA of EP3C to realize powerful processing capacity. Sampling adopted AD's AD7606 with 16 bit to ensure control accuracy.
- The switchgear can satisfy safety requirements, and the pressure-relief channel of high voltage switch can ensure safe use of operators.
- The ability of working under 2 different control modes: the V/f and vector control modes.
- BORNA-MegaDrive has a high amount of MTBF (Mean Time Between Failures) index about 100000 hours and low amount of MTTR (Mean Time To Repair) index about 10 minutes.

Technical Parameters

Parameters	Value
Capacity (kVA)	250-18750
Active power (kW)	200-15000
Input frequency (Hz)	45-65
Harmonic content injected to grid	Less than 3%
Rated input voltage (kV)	3-11
Input power factor	More than 95%
Efficiency	More than 96%
Output frequency (Hz)	0.5-120
Precision of output frequency (Hz)	0.01
Rated output current (A)	48-1000
Overload Capability	120% (1min), 1
Control mode	V/F control or V
Analog input	0-10 volt / 4-20
Analog output	0-10 volt / 4-20
Boolean input/output	Communication
Acc & Dec time (sec)	0.1-3000
Altitude	Less than 1500
Protection grade	IP30
Cooling mode	Forced air cool
Operation environment temperature (°C)	Up to 40 °C
Noise	Less than 70 dB
Communication with host	CAN, Profibus,



ALTERA's FPGA of EP3C

TI's DSP F28335



6 (for more than 20% of rated load) 6 (under a rated load)

150% (3 sec.), 200% (immediate protection) Vector control

0 mA

0 mA optional (2channels) on/Default point (expandable)

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Modbus, RS232, RS485 etc.

Configuration of BORNA-MegaDrive

BORNA-MegaDrive is a medium voltage multilevel convertor constructed by the cascade connection of single phase H-bridge inverters in series to achieve the required medium voltage output. Each single phase inverter receives input DC power from its own isolated 3-phase rectifier, itself fed with a separate transformer secondary. Each rectifier and associated inverter is assembled into an identical Power Module. BORNA-MegaDrive consists of phase shifting transformer cabinet, power unit cabinet, control cabinet and synchronization cabinet (optional).





Transformer Cabinet

This cabinet is used for installation of Phase-shift transformer with grade H insulation which is a dry type transformer with functions of temperature display and over-heat protection. The secondary multi-winding output provides phase-shift power supply to power units. This can greatly improve the current waveform on grid side and reduce the harmonic interferences.



Grid-Connected Synchronous Switching System

It is composed of the switching cabinet, a reactor cabinet and a synchronous-controller cabinet. The whole switching system is controlled synchronously by a sync-controller to ensure that the motor can be switched to the grid system smoothly from the VFD when its output voltage keep the phase-sequence and voltage value same as grid system.

Control Cabinet

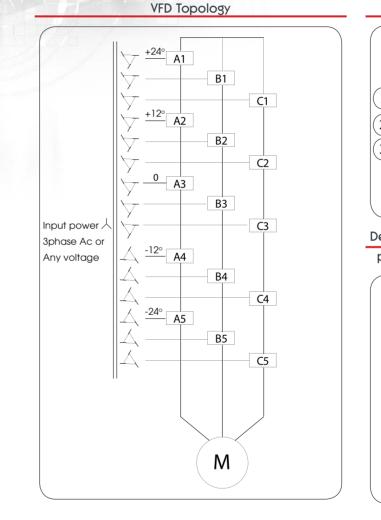
This Cabinet is used for installation of low voltage control components such as PLC, UPS, Electric siren, DC 24V power supply, Control Power Source Switch, Wiring Terminals, Touch Screen, Operation Button etc.

Furthermore, the fiber optic communication, which makes completed electric isolation between the control section and the high voltage section is used in order to ensure the safety and reliability of system.

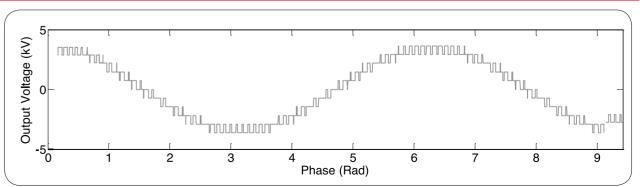


Power Cell

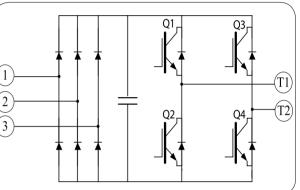
The power cell is a AC-DC structure with a 1-phase output which is fed by a 3-phase input. AC voltage from the transformer secondary winding pass through the power cells input fuses to 3-phase diode rectifier, and with capacitance filter to become smooth DC voltage. Then the DC voltage feeds a single phase H-bridge circuit with 4 IGBT and becomes single-phase AC output with variable voltage and frequency. Each power cell has the same mechanical and electrical structure, and they can be exchanged with another one.



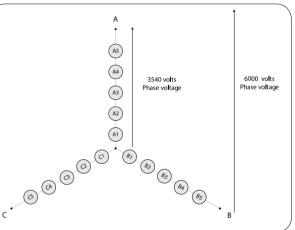
Output Line Voltage



Power cell



Developing High Voltage using series connection of power Cells for a 6kV device containing 5 blocks



Power Quality

Input and output waveforms:

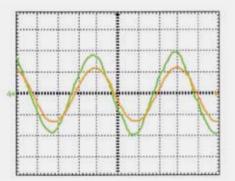
- Input Waveforms

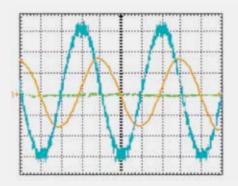
At the input side, the power cells are supplied power by phase-shifting transformer whose secondary windings are multiple structure and their electric angles are staggered, which can eliminate most of the harmonic currents drawn by the individual power cells. Hence, the input harmonic current is very low, which meets the most stringent IEEE-519-1992 and GB/T14549-93 requirements for the voltage and current harmonic distortion without filter. Furthermore, the isolation transformer ensures the lower common mode voltage and no damage to motor insulation.

- Output Waveform

Each power cell's output terminals connected in series to form Y connection to supply the motor directly. Drives can provide a sinusoidal output waveform because each power cell chooses multilevel PWM technology. In fact, drives eliminate harmful VFD-induced harmonics which cause motor heating. Similarly VFD-induced torque pulsations are eliminated (even at low speeds), thereby reducing the stress on mechanical equipments. Common mode voltage stress and dv/dt stress are also minimized. Drives need no filter and can be suitable for normal motor.

Input Voltage and Current Waveforms





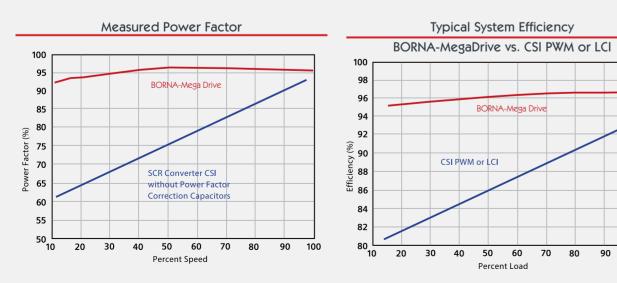
Output Vooltage and Current Waveforms

- System efficiency

In Comparison with CSI PWM or LCI, BORNA-MegaDrive has a higher amount of efficiency, about 96%, for loads more than 50%. From the other side, by changing the amount of system loading, BORNA-MegaDrive faces less fluctuation in its efficiency. System efficiency includes isolation transformer, harmonic filter, power factor correction and drive.

- Measured Power Factor

By varying motors speed from 30% to 100% of its rated amount, using BORNA-MegaDrive, total power factors only fluctuates between 95% and 97%. Total power factor includes distortion and displacement power factors.



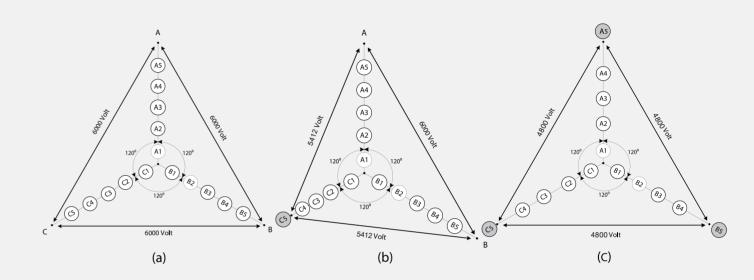
System Performance

- Reliability

BORNA-MegaDrive is designed to withstand failures that would overwhelm conventional drive systems. A traditional drive features up to five separate components, such as harmonic filter, power factor correction, transformer, power converter, and motor filter. However, for BORNA-MegaDrive isolation transformer and power converter are the only major required components.

In BORNA-MegaDrive, a series of low-voltage cells are linked together to build the medium-voltage power output of the drive system. This configuration delivers for you when it comes to ease of maintenance, power quality, and reliability. It also provides the basis for one of its most important advantages — increased availability through the advanced cell bypass option

Phasor diagram of a 11-level output voltage of a BORNA-MegaDrive (a) Normal operation. (b) Operation under fault 5-5-4. (c) Balanced operation under fault 4-4-4



- Versatility

BORNA-MegaDrive technology meets the needs of customers in almost any industry that employs motors, fans, or pumps. These drives can accept many different input voltages and can provide motor output voltages up to 11 kV. BORNA-MegaDrive is compatible with your existing motor systems, regardless of age, brand, or voltage frequency — even synchronous motors can be upgraded. Furthermore, you can be sure that the BORNA-MegaDrive is compatible with your power system because it meets the most stringent IEEE 519 1992 requirements for current harmonic distortion. We meet those guidelines without filter or harmonic mitigation equipment — the BORNA-MegaDrive de-

sign includes a transformer that employs phase shifting technology to eliminate harmonic distortion at the source.

- Efficiency

100

One of the most inefficient power events occurs at motor start-up. Typically, a motor slams on — going from off to 100 percent — with the flick of a switch. By contrast, the soft start features of the BORNA-MegaDrive decrease stresses that can limit the life of your equipment — gradually increasing power to smoothly initiate power output with full rated torque available during acceleration from zero speed, but without any current inrush into the motor. Additionally, overall design integration helps provide quick and reliable start-ups and allows the addition of power conversion redundancy. It all adds up to give you a smaller, more efficient and reliable system.

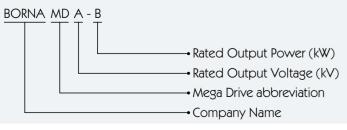
Product type

Voltage Level V (kV)	Output Power P (kW)	W×D×H (mm)	Weight (kg)
	P≤1000	3780×1200×2200	3000-3500
	1000 <p≤1250< td=""><td>4500×1200×2200</td><td>3600-4000</td></p≤1250<>	4500×1200×2200	3600-4000
3-3.3	1250 <p≤1600< td=""><td>4500×1200×2200</td><td>4400-5000</td></p≤1600<>	4500×1200×2200	4400-5000
	1600 <p≤2500< td=""><td>Customization</td><td>5500-6000</td></p≤2500<>	Customization	5500-6000
	P≥2500	Customization	Customization
	P≤1000	3780×1200×2200	3000-3500
	1000 <p≤1250< td=""><td>4500×1200×2200</td><td>3600-4000</td></p≤1250<>	4500×1200×2200	3600-4000
4.160	1250 <p≤1600< td=""><td>4500×1200×2200</td><td>4400-5000</td></p≤1600<>	4500×1200×2200	4400-5000
	1600 <p≤2500< td=""><td>Customization</td><td>5500-6000</td></p≤2500<>	Customization	5500-6000
	P≥2500	Customization	Customization
	P≤1000	3780×1200×2200	3200-3800
	1000 <p≤1250< td=""><td>3980×1200×2200</td><td>3700-4200</td></p≤1250<>	3980×1200×2200	3700-4200
	1250 <p≤1600< td=""><td>3980×1200×2200</td><td>5000-5500</td></p≤1600<>	3980×1200×2200	5000-5500
	1600 <p≤2000< td=""><td>4360×1400×2200</td><td>5500-6000</td></p≤2000<>	4360×1400×2200	5500-6000
6-6.6	2000 <p≤2500< td=""><td>4880×1400×2200</td><td>6500-7000</td></p≤2500<>	4880×1400×2200	6500-7000
	2500 <p≤3200< td=""><td>6080×1400×2200</td><td>7500-8500</td></p≤3200<>	6080×1400×2200	7500-8500
	3200 <p≤4000< td=""><td>Customization</td><td>8500-9500</td></p≤4000<>	Customization	8500-9500
	4000 <p≤5000< td=""><td>Customization</td><td>9500-10500</td></p≤5000<>	Customization	9500-10500
	P≥5000	Customization	Customization
	P≤1000	4300×1200×2200	3500-4000
	1000 <p≤1250< td=""><td>5850×1200×2200</td><td>4000-5000</td></p≤1250<>	5850×1200×2200	4000-5000
	1250 <p≤1800< td=""><td>6500×1200×2200</td><td>5000-6000</td></p≤1800<>	6500×1200×2200	5000-6000
	1800 <p≤2300< td=""><td>7280×1400×2200</td><td>6000-6500</td></p≤2300<>	7280×1400×2200	6000-6500
10.11	2300 <p≤3200< td=""><td>7880×1400×2200</td><td>6500-7500</td></p≤3200<>	7880×1400×2200	6500-7500
10-11	3200 <p≤4000< td=""><td>Customization</td><td>7500-8000</td></p≤4000<>	Customization	7500-8000
	4000 <p≤5000< td=""><td>Customization</td><td>8000-9000</td></p≤5000<>	Customization	8000-9000
	5000 <p≤6500< td=""><td>Customization</td><td>9000-10500</td></p≤6500<>	Customization	9000-10500
	6500 <p≤8800< td=""><td>Customization</td><td>10500-12500</td></p≤8800<>	Customization	10500-12500
	P≥8800	Customization	Customization

	3 – 3.3 kV series	4.160 kV series	6 - 6.6 kV series	10 – 11 Kv series
Transformer Capacity	250-7125 kVA	250-9000 kVA	250-14200 kVA	250-18750 kVA
Adapted Motor Power	200-5700 kW	200-7200 kW	200-11500 kW	200-15000 kW
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Model and Identification:



User Interface Control Power supply (AC 380 V) 24 V Remote Start Remote Stop Remote Reset Remote Emergency Stop S Frequency Lock side Spare inputs Spare Spare Remote Speed Preset

Back up (4-20 mA)

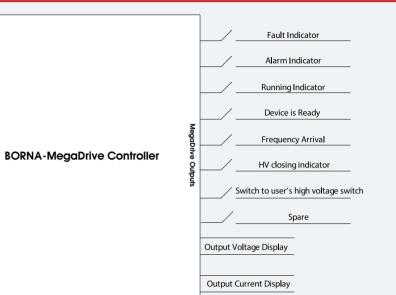
MegaDrive Controller Inputs

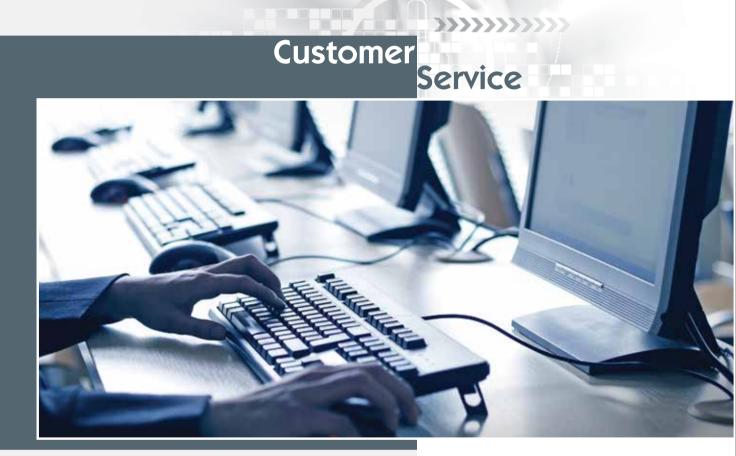
	Function	Interface Type	Description
1	Control Power (AC 380 or AC 220)	3phase 4 wire/ 1phase 2 wire	Supply power for control system and cooling fan
2	Remote Start	Dry Contact/Communication	Frequency rise to preset value according to preset Acc curve
3	Remote Stop	Dry Contact/Communication	Frequency decrease to 0 Hz according to preset curve
4	Remote Reset	Dry Contact/Communication	Fault protection
5	Remote Emergency Stop	Dry Contact/Communication	Emergency Stop when fault happened
6	Frequency Lock	Dry Contact/Communication	Frequency inverter operate according to remote preset frequency
7	Spare	Dry Contact/Communication	
8	Spare	Dry Contact/Communication	
9	Spare	Dry Contact/Communication	
10	Remote Speed Reset	Analog/Communication	Preset input frequency remotely
11	Spare	Analog/Communication	

MegaDrive Controller Outputs

	Function	Interface Type	Description
1	Fault Indicator	Dry Contact/Communication	Indicate heavy faults
2	Alarm Indicator	Dry Contact/Communication	Indicate light faults
3	Running Indicator	Dry Contact/Communication	Indicate running
4	Device is Ready	Dry Contact/Communication	Indicate inverter is ready
5	Frequency reached	Dry Contact/Communication	Indicate frequency rise to preset value
6	HV closing Indicator	Dry Contact/Communication	Indicate inverter allows high voltage dosing
7	Switch to user network	Dry Contact/Communication	Indicate heavy fault happened, inverter must shift to user network
8	Spare	Dry Contact/Communication	
9	Output Voltage Display	Analog/Communication	Display inverter running voltage
10	Output Current Display	Analog/Communication	Display inverter running current

MegaDrive Controller





Perfect quality and service system

The company complies with 1S09001 : 2008 strictly to carry out production, process etc.

Consultant Services

Investigating and surveying onsite, providing feasibility study report, assisting in equipment specification selection, analyzing estimated energy saving effects etc. are some of BORNA Co. services. Furthermore, some services such as providing on-site installation, debugging and training, operator training, and energy saving measurement and estimation are part of our services.

After sale Service

All 24 hours of day services such as providing lifetime maintenance, onsite fault diagnosis, and remote diagnosis is available for all BORNA MV-VFD users.

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