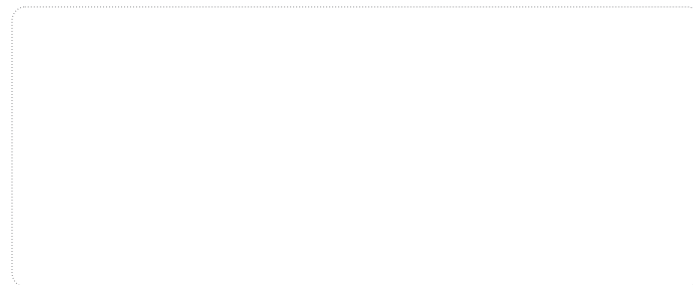


BPJ1 Series

Explosion-proof Inverters For Mining

Your trusted industry automation solution provider



Service line: 86-755-86312859 E-mail: overseas@invt.com.cn

SHENZHEN INVT ELECTRIC CO., LTD.

No. 4 Building, Gaofa Scientific Industrial Park, Longjing, Nanshan District, Shenzhen, China

- Industrial Automation:** ■ Frequency Inverter ■ Servo & Motion Control ■ Motor & Electric Spindle ■ PLC
 ■ HMI ■ Intelligent Elevator Control System ■ Traction Drive
- Electric Power:** ■ SVG ■ Solar Inverter ■ UPS ■ Online Energy Management System

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201404 (V1.0)



Explosion-proof | **Safe**
Reliable



BPJ1 Series



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Product Overview

• Product Introduction

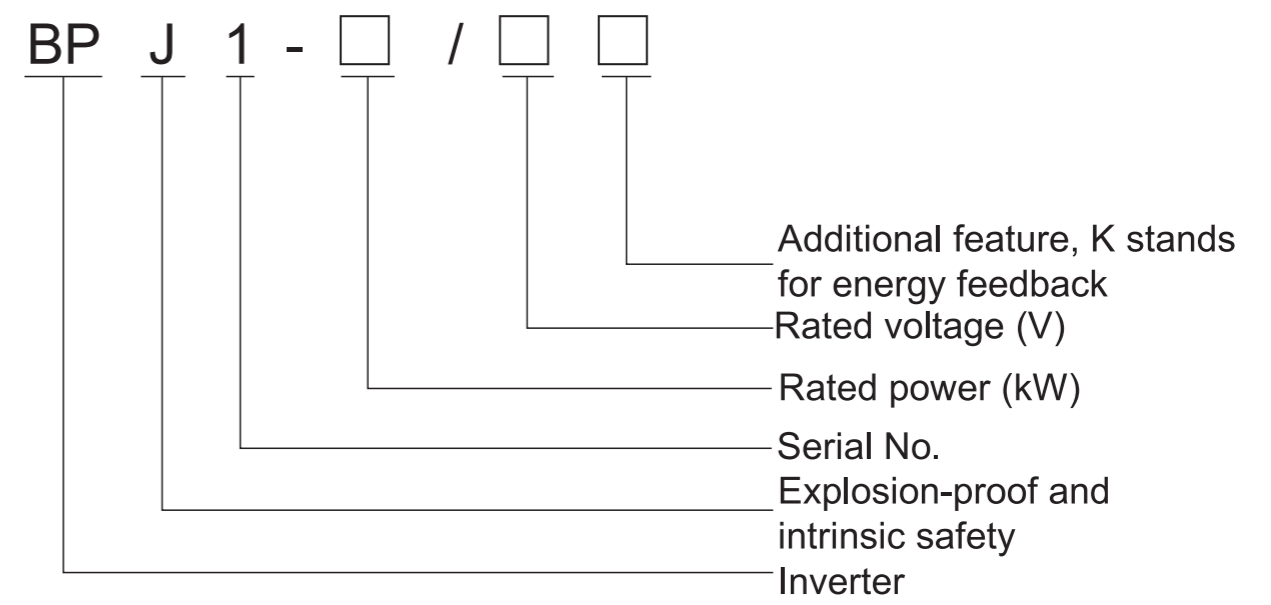
BPJ1 series explosion-proof and intrinsic safety inverters for mining are the special products developed by INVT on basis of years of R&D experience to meet the specific requirements of customers in mining industry.

Due to accurate understanding of market demands, advanced development and management of integrated products, overall R&D and test, automation and information in production, BPJ1 series products have the outstanding features of leading technology, high reliability and easy maintenance.

The products have passed the strict test from MA Center, Mining Products Safety Approval and Certification Center (MA Center) is independent legal entity organization authorized by State Administration of Work Safety (SAWS), completely meet the requirements of electrical devices used under coal mines and widely apply to conveying, hoisting, ventilating and power devices.



• Type Designation Key



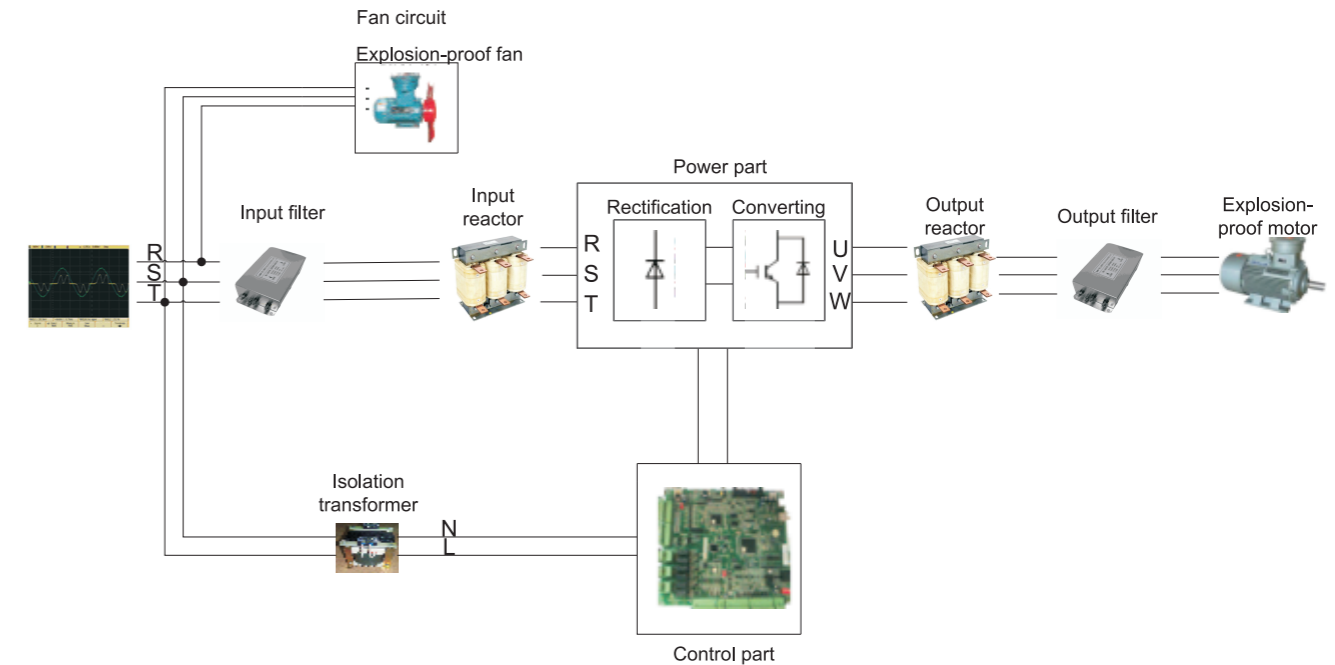
• Product Selection

Model		Rated power (kW)	Input rated current (A)	Output rated current (A)	Outside dimension (W*H*D) (mm)	Weight (kg)
660V two-quadrant	BPJ1-055/660	55	65	63	810*1050*935	1000
	BPJ1-075/660	75	85	86	1700*1145*1080	1310
	BPJ1-090/660	90	95	98	1700*1145*1080	1310
	BPJ1-110/660	110	118	121	1700*1145*1080	1310
	BPJ1-132/660	132	145	150	1955*1000*1230	1700
	BPJ1-160/660	160	165	175	1955*1000*1230	1700
	BPJ1-185/660	185	190	198	1955*1000*1230	1700
	BPJ1-200/660	200	210	218	2245*1220*1360	2500
	BPJ1-250/660	250	255	270	2245*1220*1360	2500
	BPJ1-280/660	280	290	320	2245*1220*1360	2500
	BPJ1-315/660	315	334	350	2245*1220*1360	2500
	BPJ1-400/660	400	411	430	2245*1220*1360	2600
BPJ1-500/660	500	518	540	2245*1220*1360	2600	
1140V two-quadrant	BPJ1-110/1140	110	70	73	1700*1145*1080	1246
	BPJ1-160/1140	160	101	104	1955*1000*1230	1800
	BPJ1-200/1140	200	126	132	1955*1000*1230	1800
	BPJ1-250/1140	250	158	162	1955*1000*1230	1800
	BPJ1-315/1140	315	200	208	2245*1220*1360	2500
	BPJ1-400/1140	400	260	260	2245*1220*1360	2500
	BPJ1-500/1140	500	325	325	2245*1220*1360	2500
BPJ1-630/1140	630	400	400	2715*1140*1375	2800	
660V four-quadrant	BPJ1-132/660K	132	122	150	Converting cabinet: 1875*1165*1390 Filtering cabinet: 1675*1265*1285	1780 1080
	BPJ1-160/660K	160	147	175	Converting cabinet: 1875*1165*1390 Filtering cabinet: 1675*1265*1285	1780 1080
	BPJ1-185/660K	185	170	198	Converting cabinet: 1875*1165*1390 Filtering cabinet: 1675*1265*1285	1780 1080
	BPJ1-200/660K	200	184	218	Converting cabinet: 1875*1325*1390 Filtering cabinet: 1675*1265*1285	2100 1350
	BPJ1-250/660K	250	230	270	Converting cabinet: 1875*1325*1390 Filtering cabinet: 1675*1265*1285	2100 1350
	BPJ1-315/660K	315	290	350	Converting cabinet: 1875*1325*1390 Filtering cabinet: 1675*1265*1285	2100 1350

• Working Principle

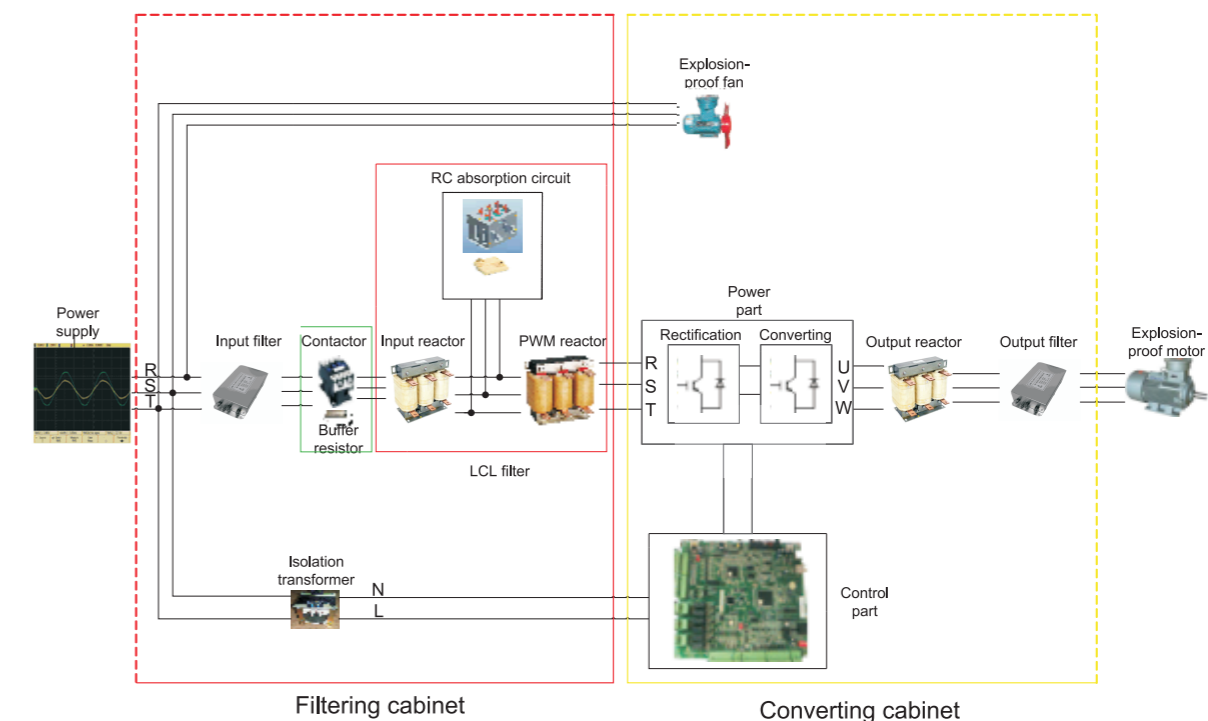
BPJ1 two-quadrant explosion-proof inverter

Adopt diode rectification, simple and reliable, inverter and motor work only in motoring condition, be suitable for common loads such as belt conveyors, scrapers, fans and water pumps



BPJ1 four-quadrant explosion-proof inverter

Adopt IGBT power module rectification, by precise software algorithm modulation, convert kinetic energy released by the motor into electric energy back to the grid, realize bidirectional energy flow, be suitable for large-inertia loads such as hoists, winches and aerial riding devices



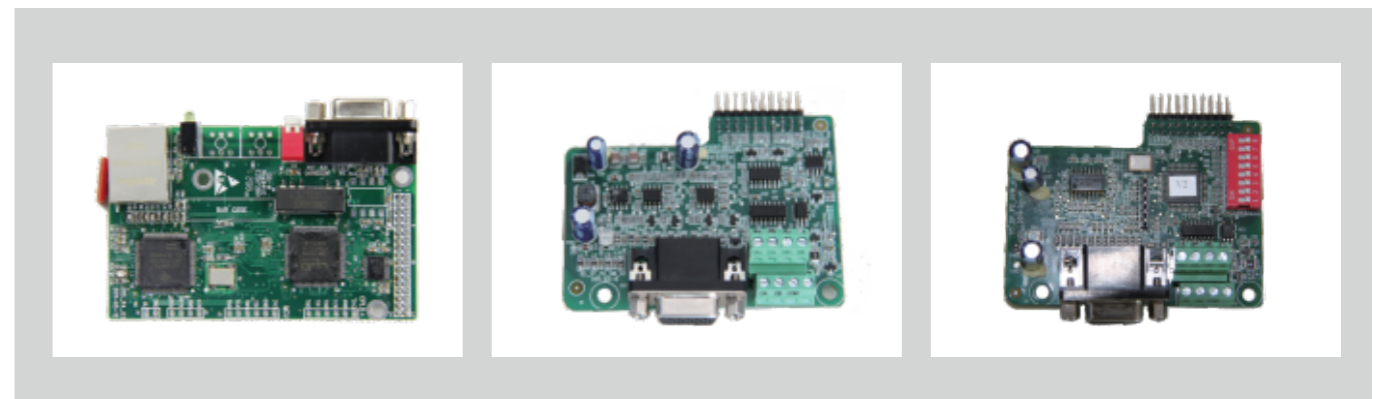
General Parameters

Model		660V two-quadrant series	660V four-quadrant series	1140V two-quadrant series	1140V four-quadrant series	
Input	Input voltage range	560V~760V	560V~760V	970V~1310V	970V~1310V	
	Input frequency range	47~63Hz				
Technical and operating control performance	Control mode	V/F, sensorless vector control (SVC), vector control (VC)				
	V/F control	Linear type, multi-dots type, multi-power V/F curve, V/F separation				
	Running command channel	Keypad, terminal, communication				
	Frequency reference method	Digital reference, analog reference, pulse frequency reference, communication reference, multi-step speed and simple PLC reference, PID reference, etc.				
	Power balance function	Master-slave communication, droop control				
	Overload capability	150% of rated current 60s, 180% of rated current 10s				
	Starting torque	0.5Hz 150% (SVC), 0Hz 180% (VC)				
	Speed control range	1:100 (SVC), 1:1000 (VC)				
	Speed control precision	±0.5% of Max. speed (SVC), ±0.1% of Max. speed (VC)				
	Frequency resolution	Digital setting: 0.01Hz Analog setting: 0.1%~Max. frequency				
	Torque boost	Automatic torque boost, manual torque boost 0.1~30.0%				
	ACC/DEC method	Straight line or S curve, four groups of ACC/DEC time				
	DC braking	DC braking at starting, DC braking at stopping				
	Jogging running	Jogging frequency range: 0.0Hz~Max. output frequency Jogging ACC/DEC time: 0~3600.0S				
	Simple PLC and multi-step speed running	Realize up to 16-step speed running via built-in PLC or control terminals				
	Built-in PID function	Realize close loop control system of process quantities				
	Automatic voltage regulation	Keep the output voltage constant automatically when the grid voltage changes				
	Torque reference method	Keypad reference, analog reference, high-speed pulse frequency reference, remote communication reference				
	Protection function	Up to 30 protection functions such as overcurrent, overvoltage, undervoltage, overtemperature, phase loss, overload and short circuit protection				
	Display	Standard LED display, optional LCD display				
	Communication	Standard: Ethernet Optional: PROFIBUS, CAN, Rs485	Standard: RS485, CAN, Ethernet Optional: PROFIBUS	Standard: RS485, CAN, Ethernet Optional: PROFIBUS, optical fiber	Standard: RS485, CAN, Ethernet Optional: PROFIBUS, optical fiber	
	Explosion-proof mark	Ex d [ib] Mb				
	Explosion-proof type	Explosion-proof and intrinsic safety				
	Running environment	Temperature	-10°C~50°C; if above 40°C, derate 3% for every additional 1°C			
		Altitude	1000m below; if above 1000m, refer to altitude derating table for derating coefficient			
		Humidity	Relative humidity 5%~95%; no condensation			
Application	Belt conveyors, local fans, emulsion pumps, scrapers, water pumps	Hoists, winches, aerial riding devices, coal winning machine, down belt conveyors	Belt conveyors, local fans, emulsion pumps, scrapers, water pumps	Hoists, winches, aerial riding devices, coal winning machine, down belt conveyors		

Optional Card Accessory Selection Table

Name	Model	Description	660v two quadrant	660v four quadrant	1140v two quadrant
I/O Extended Card 1	PW119-TF1-01	I/O Interface (DI*4, Collector Output*1, AO*1)	⊙		
		Relay Interface *1			
		485 Communication Interface			
		CAN Communication Interface			
Incremental Encoder PG Card (Asynchronous Motor)	EC-PG101-12	Output Power Supply: 12V±5%, the maximum current 350mA Input Signal: differential and push-pull encoder A, B, Z signal	⊙		
	EC-PG101-24	Output Power Supply: 24V±5%, the maximum current 350mA Input Signal: differential and push-pull encoder A, B, Z signal	⊙		
Sine-cosine Encoder PG Card (Synchronous Motor)	EC-PG102-05	Output Power Supply: 5V±5%, the maximum current 350mA Input Signal: two orthogonal frequency division differential output, collector output	⊙		⊙
UVW Encoder PG Card (Synchronous Motor)	EC-PG103-05	Output Power Supply: 5V±5%, the maximum current 350mA Input Signal: two orthogonal frequency division differential output, collector output (In addition: support the signal processing of 5V incremental encoder, keep the input connection mode in accordance with the incremental encoder PG card.)	⊙		
Resolver PG Card (Synchronous Motor)	EC-PG104-05	Output Power Supply: 5V±5%, the maximum current 350mA It's suitable for the synchronous motor and rotating encoder under feedback situation.	⊙		
Communication Card	EC-TX103	PROFIBUS + Ethernet	⊙	⊙	⊙
	EC-TX104	CAN + Ethernet	⊙		
I/O Extended Card 2	PW119-TF1-02	I/O Interface (AI*2, AO*2, HDI*1, HDO*1)			⊙
		Relay Interface (2 AC250V/3A)			
		Fiber Interface			
		Incremental Encoder Interface (Asynchronous Motor)			

As for 660V two-quadrant, 660V four-quadrant and 1140V two-quadrant; please refer to BPJ1 series inverter operation manual or contact us.

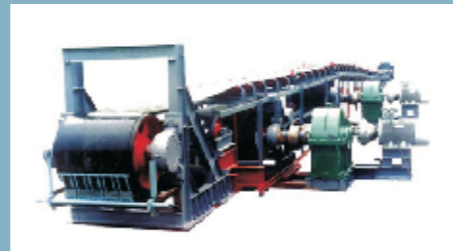


Applications

BPJ1 inverters applied on belt conveyors in mines

Illustration of belt conveyors in mines

- The belt conveyor is a general machine mainly used for continuous transportation. It includes the components of motor, reducer, belt, chassis, driving pulley, bend pulley, carrying idler, return idler and tension devices.
- Generally, there are several motors driving one belt, so the belt conveyor has a quite high requirement to the power balance of these motors



Control requirements

- With outstanding low frequency torque characteristic, it can start normally with heavy load.
- With excellent master-slave control logic, it can balance the power of several motors.
- Wide speed range, great soft start performance.
- Strong overload ability and environment adaptability, high running reliability.
- Wide input voltage range, automatic voltage regulation function.

Scheme design & illustration

- Electric drive condition: The whole conveyor is driven by four parallel 1140V asynchronous motors which are connected to the driving pulleys of the conveyor by the reducers. The snake-like spring couplings are used between the motors and reducers, the reducers and driving pulleys. The motors are coaxial motors—two motors control one pulley.
- Four BPJ1-250/1140 inverters respectively control four asynchronous motors in the system, with one inverter to be the master and the other three to be slaves. The master-slave control function enables all slaves automatically to follow the master running dynamically, and thus the power of 4 motors can be balanced.
- To operate the frequency conversion speed control system only needs to operate the master, either by the keypad of the master or by the upper working platform controlling the system in a long distance.

Scheme advantages

- The slow start of the motor drives the belt conveyor to start slowly, and slowly releases the energy stored in the belt without any damage. In practice, the motor soft start combines with the belt conveyor soft start.
- Stable starting characteristic of the equipment greatly reduces the maintenance.
- Excellent master-slave control function facilitates the power balance of four motors and prolongs their lives.
- The motor adjustment in accordance with practical conditions brings significant energy saving effect.
- The design of $\pm 15\%$ wide power grid meets the requirements of the grid under severe environment.

BPJ1 inverters applied to mine hoists

Illustration of mine hoists

- The whole hoisting process of the mine hoist can be divided into five stages of acceleration, constant speed, deceleration, creeping and stop brake. During acceleration stage, the hoist accelerates to the maximum speed from static state. The constant speed stage is the main stage at which the hoist runs under constant maximum speed. During deceleration stage, the hoist decelerates to the creeping speed from the maximum speed. The creeping stage is for skip location and safe stopping preparation.
- Its working characteristic: The skip repeats moving up and down at a quite high speed in a certain depth. According to its working characteristic, to ensure the hoist can continuously work with high efficiency, safety and reliability, it must possess good mechanical performance, great electric control devices and perfect protection equipment are needed.



Control requirements

- Good speed control performance
- High speed control precision
- Four-quadrant operation
- Quickly running forward to reversely, fast dynamic response
- High reliability

Scheme design & illustration

- Electric drive condition: The console gives the command to the inverter which will drive the explosion proof motor. Then the motor makes the pulley rotate where the steel wire rope will catch a coal cart after winding several cycles. Under the driving of the motor, the cart full of coal will be pulled up; after unloading, the empty cart will be pulled down along the inclined shaft by the motor. When the hoist needs to stop, the console gives the command to the pulley for stop brake.
- The system consists of the power installation, hydraulic station, BPJ1-500/660K four-quadrant inverter, console and control monitoring system. The power installation contains the master motor (YVF400L1-6), reducer, pulley and brake.
- The console is connected to the inverter by PLC. (Achieve the switchover between forward and reverse rotation through the multifunction terminals, S1 and S2; S3 is the reset terminal of the inverter; S4, S5, S6 realize the functions of the rope, constant speed 1 and constant speed 2 by setting the multi-step speed.) Thus, it operates the inverter as well as set the interlocking between the brake signals and forward/reverse rotating signals, the inverter fault signals and system safety circuit through external terminals.

Scheme advantages

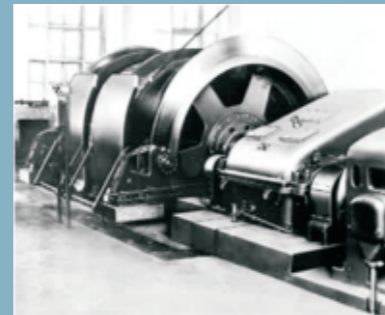
- Wide grid voltage range with $\pm 15\%$ fluctuation; constant torque boost reduces the impact to the load caused by grid fluctuation.
- Four-quadrant operation of the motor.
- Stepless speed regulation of the motor can stabilize both the acceleration stage and the deceleration, as well as reduce the current impact.
- Control by the chips and external circuit interface of PLC, making the system more reliable.
- Complete safety protections. Besides the self protection of overvoltage, overload and overheat, there are interlocking protection of peripheral control, such as the interlocking between the brake signals and forward/reverse rotating signals, the inverter fault signals and system safety circuit, and so on.



BPJ1 inverter applied in scraper conveyor

Illustration of scraper conveyor

- Scraper conveyor is a continuous flexible traction transport machinery for mining coalface and roadway. Its traction is the scraper chain and the carrying device is the chute. The chain is at the bottom of the chute.
- Scraper conveyor is mainly composed of the head, body, tail and auxiliary equipment. Its drive device is the head part, including head frame, motor, hydraulic coupler, speed reducer, main head shaft and sprocket components. In application, the motors make the scraper move in the chute and convey the coal through the coupler, speed reducer, main head shaft and guide chain.



Control requirements

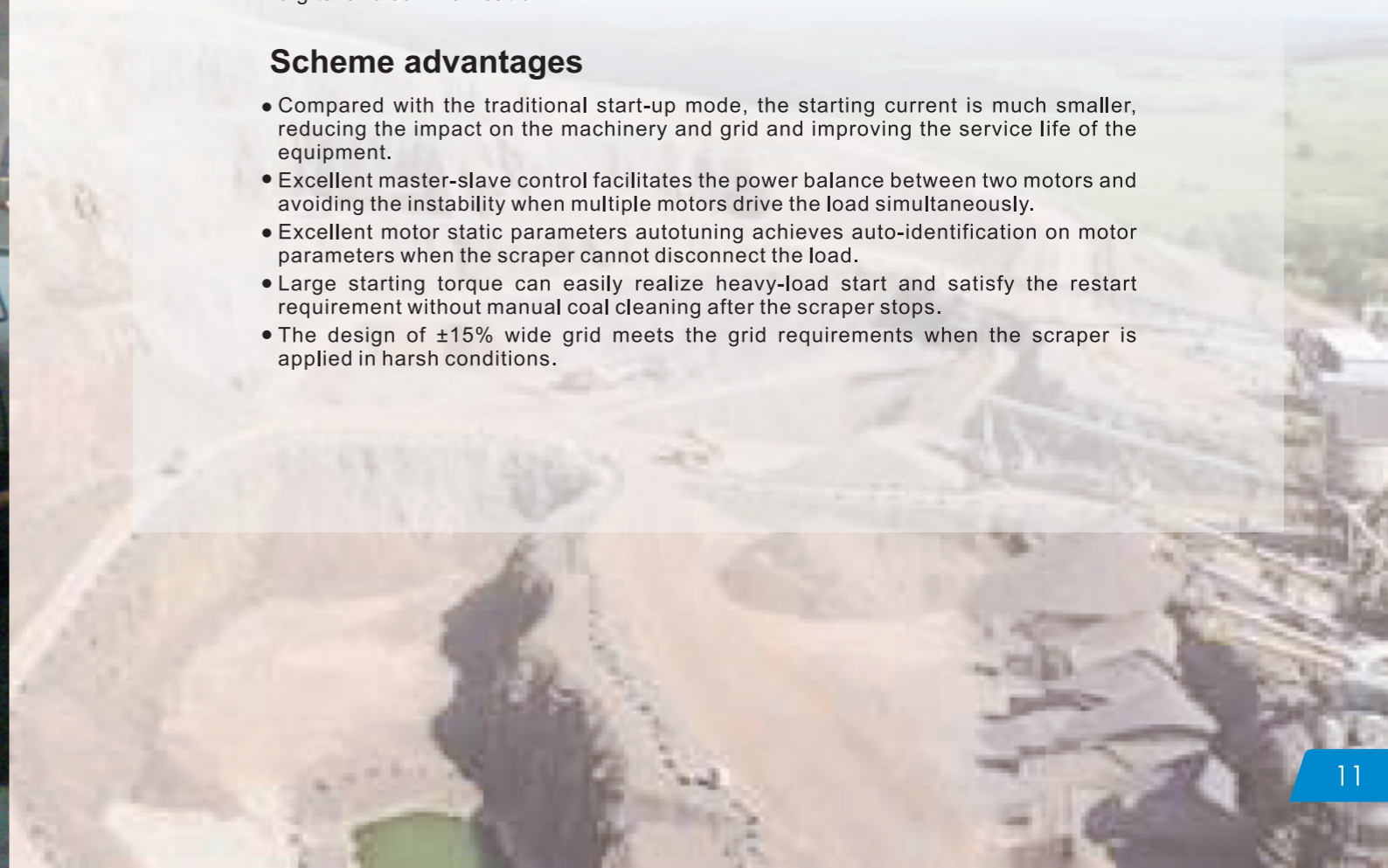
- Starting current as small as possible, reducing the impact on the machinery and grid
- Adjustable output torque and speed, starting smoothly
- Multi-motor power balance, ensuring balancing and synchronous load among motors
- Motor static parameters autotuning, achieving system commissioning easily
- Feasible heavy-load start
- Wide range of speed regulation, high soft start performance
- Strong overload capability and environmental adaptability, high operational reliability
- Wide range of input voltage, AVR (Automatic Voltage Regulation) function

Scheme design & illustration

- Electric drive conditions: Two inverters respectively drive two motors at the head and tail, then the motors make the scraper move in the chute and convey the coal through the coupler, speed reducer, main head shaft and guide chain.
- Two BPJ1-315/660 inverters (one as the master, the other as the slave) are used to control two 280kW asynchronous motors. Additionally, proven communication methods are adopted to realize master-slave control and satisfy multi-motor power balance.
- BPJ1 inverter adopts V/F control mode, with excellent low-speed and large-torque starting features meeting the requirements of soft start and heavy-load start of the scraper.
- The variable frequency speed control system only needs to operate the master, either by the keypad of the master or by the various modes such as external analog, digital and communication.

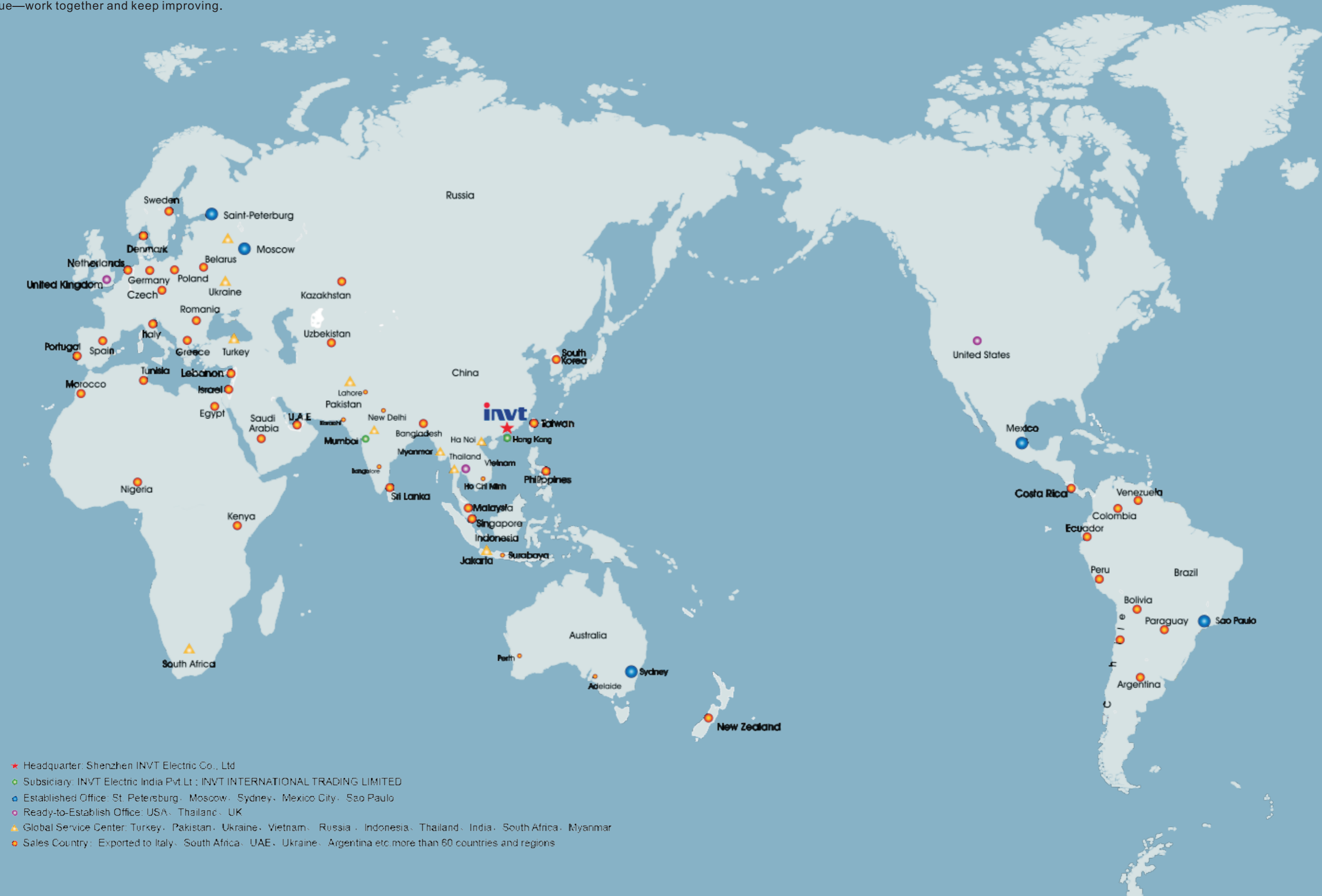
Scheme advantages

- Compared with the traditional start-up mode, the starting current is much smaller, reducing the impact on the machinery and grid and improving the service life of the equipment.
- Excellent master-slave control facilitates the power balance between two motors and avoiding the instability when multiple motors drive the load simultaneously.
- Excellent motor static parameters autotuning achieves auto-identification on motor parameters when the scraper cannot disconnect the load.
- Large starting torque can easily realize heavy-load start and satisfy the restart requirement without manual coal cleaning after the scraper stops.
- The design of $\pm 15\%$ wide grid meets the grid requirements when the scraper is applied in harsh conditions.



Global Sales Network

The INVT overseas technical support center provides all-around service by quick response to client's request, rapid integration of company resources and efficient solution of after-sales problems, to embody the core value—work together and keep improving.



- ★ Headquarter: Shenzhen INVT Electric Co., Ltd
- Subsidiary: INVT Electric India Pvt.Lt : INVT INTERNATIONAL TRADING LIMITED
- Established Office: St. Petersburg, Moscow, Sydney, Mexico City, Sao Paulo
- Ready-to-Establish Office: USA, Thailand, UK
- ▲ Global Service Center: Turkey, Pakistan, Ukraine, Vietnam, Russia, Indonesia, Thailand, India, South Africa, Myanmar
- Sales Country: Exported to Italy, South Africa, UAE, Ukraine, Argentina etc.more than 60 countries and regions