

**HITACHI**  
Inspire the Next

# HIVECTOR-HVI



**Medium Voltage Multi-level IGBT Drives**

# Over 75 Years of Experience in Variable Speed Drives

Based on lengthy experience in drive systems for steel rolling mills, Hitachi supplies AC drive systems to various industry applications including mixers and extruders for the plastics and rubber industry, induced and forced draft fans for thermal power plants, pumps for water purification plants and water and waste water treatment facilities, and fans and blowers for general applications.

Mega power AC drives also have applied to Primary-Loop Recirculation (PLR) Pumps for nuclear power plants, wind mill power converters, dump truck drives for mining industry, compressor drives for oil & gas industry and propulsion drives for ice breaker ships.

## DC Motor to AC Motor Drives

# HIGHLIGHTS



**1973**

DC drive controls, HILECTOL, delivered



**1982**

The world's first Digital Thyristor Leonard Drives delivered



**1986**

Medium Voltage AC Drives for steel rolling mills delivered

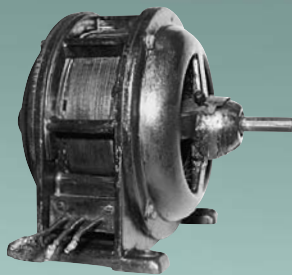
**1933**  
Ward Leonard Drives for steel rolling mills delivered

**1958**  
Mercury-arc Rectifier applied Ward Leonard Drives for steel rolling mills delivered

**1930-1960**

**1970**

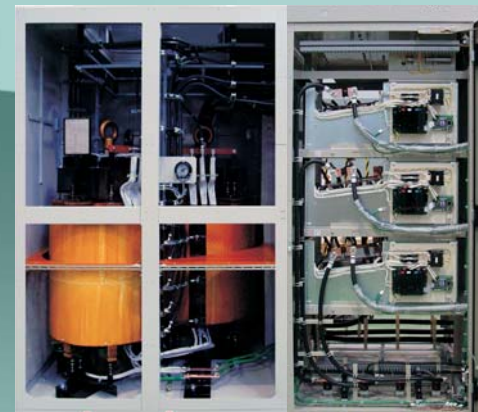
**1980**



**1910**

**The first products of HITACHI**

Hitachi was founded in 1910 as an electrical repair shop for a mining company and succeeded in the first domestic manufacture of three 5 HP motors as the company's first products.



Multi-winding isolation transformer

Cell Inverter

# Direct Inverter Controls



**1995**  
20MVA GTO Drives for steel rolling mills delivered



**1999**  
Medium Voltage Multi-level IGBT Drives, HIVECTOL-HVI, delivered



**2001**  
8MVA HIVECTOL-HVI for utility thermal power plants delivered



**2007**  
30MVA IGBT Drives for steel rolling mills delivered

**2004**  
Multi-level IGBT drive production started in China

**2009**  
30MVA 5-Level water cooled IGBT Drives for industry application

1990

2000

2010

## HIVECTOL

### Features

#### Power Source and Machine Friendly

- Current harmonic at the power source conforms the IEEE 519-1992 guidelines without line side harmonic filters.
- Multi-level PWM approximates output waveforms to sine curves and reduces motor insulation stress.
- Multi-winding isolation transformer and diode converter help achieve a power factor of 0.95 or better.

#### State-of-the-art Technology and High Performance

- Stable operation is assured for applications needing high starting torque and high intermittent torque.
- Patented "external precharging method" helps reduce the parts count and down time.
- Automatic restarting function helps continuous operation in cases of instant power failure.
- Motor Speed accuracy is  $\pm 0.5\%$  at the rated 100% speed without a speed sensor device. ( $\pm 0.1\%$  with speed sensor device)

#### High Reliability

- IGBT, the most reliable, available and widely installed power semiconductors in industry are used.
- Quality production in manufacturing eliminates human error during manufacturing.
- "Realtime simulator" helps prevent axial vibration and minimize the commissioning period.

#### Operator Friendly

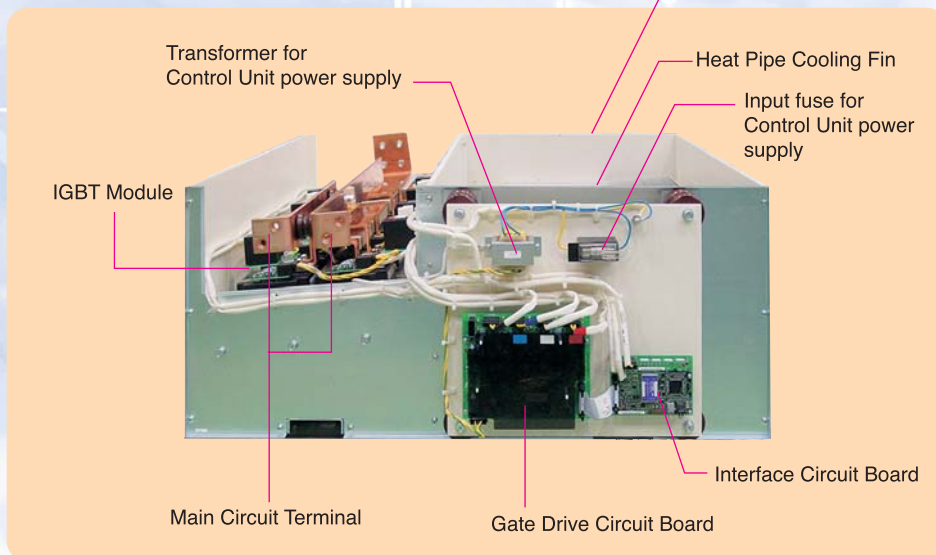
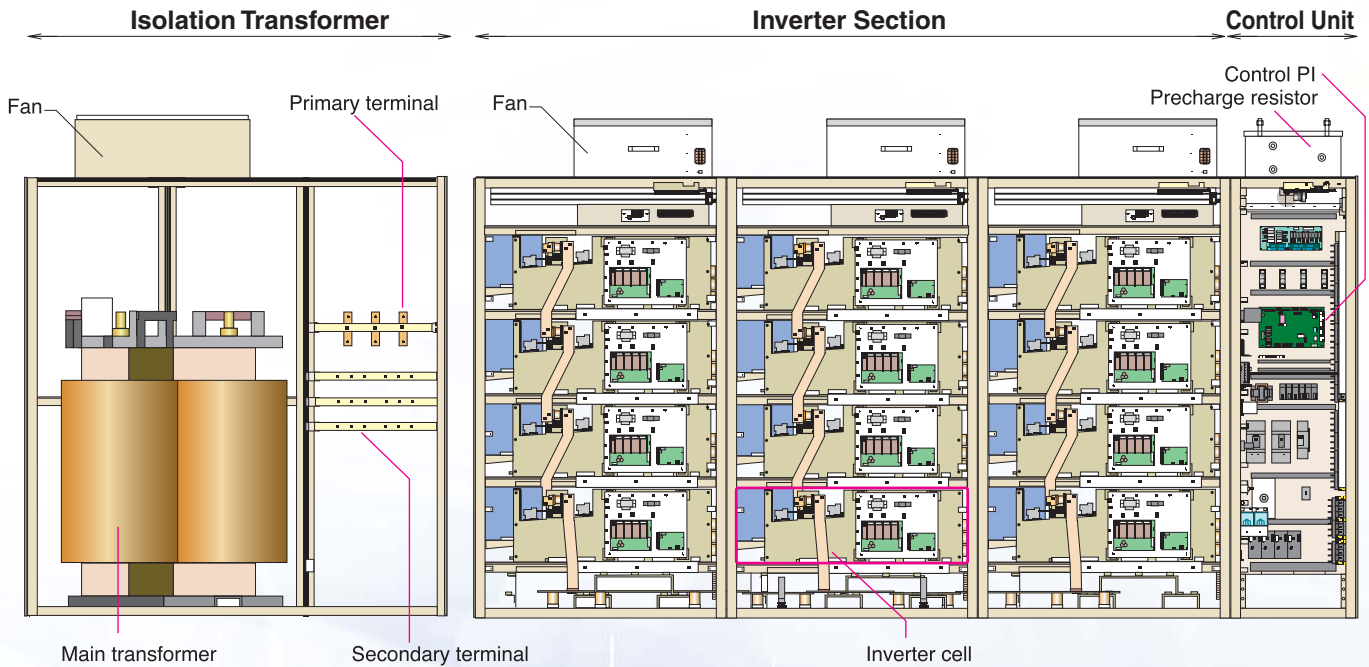
- Large touch-screen panel shows easy-to-understand information and assures user friendly operation.
- Windows® PC based maintenance software is supplied by Hitachi for user friendly operation.



Control Unit

## HIVECTOL HVI Hardware Overview

Main components of HIVECTOL-HVI are the “Isolation Transformer”, “Inverter Section” and “Control Unit”. Inverter Section is composed of a series-connected “Inverter Cell”. Isolation Transformer is a phase shifted multi-winding type. Control Unit has functions such as IGBT inverter switching, an interface to external equipment, and so on.



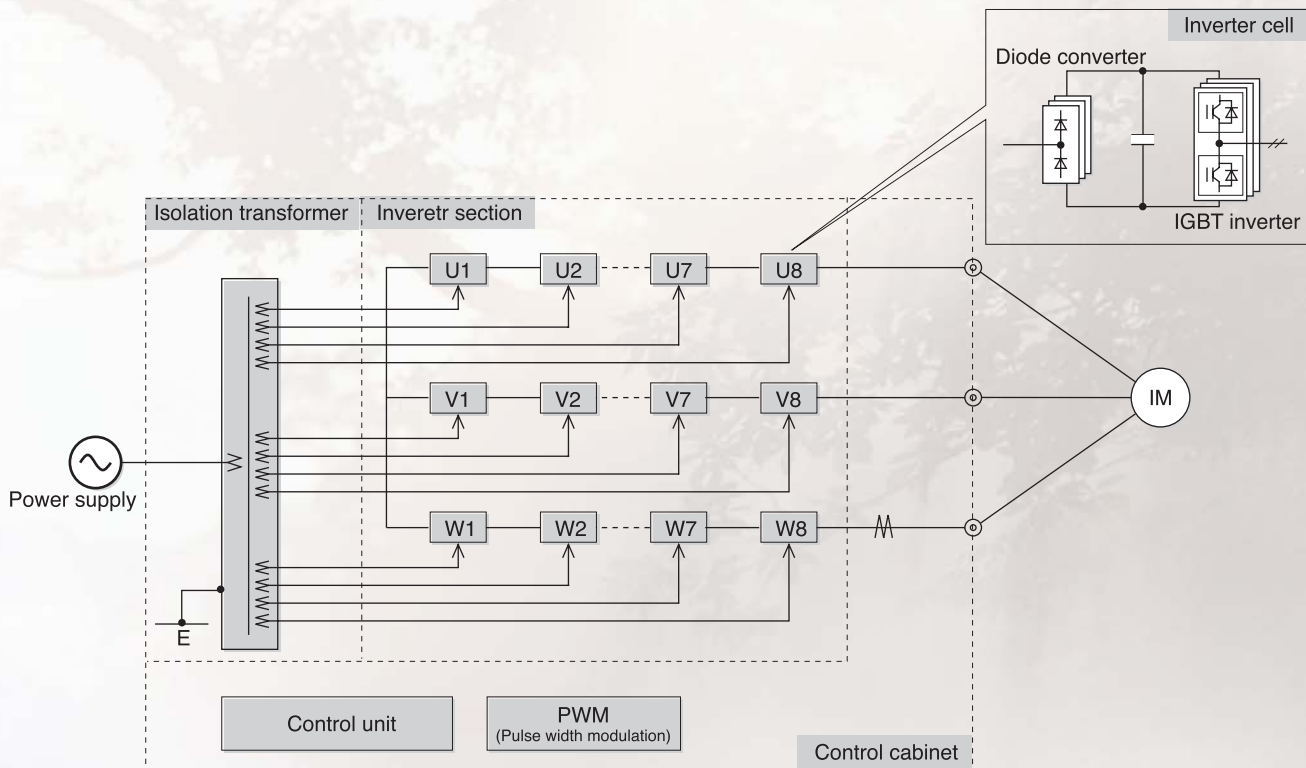
## Power Source and Machine Friendly

Inverter Cell is composed of a diode converter and IGBT inverter.

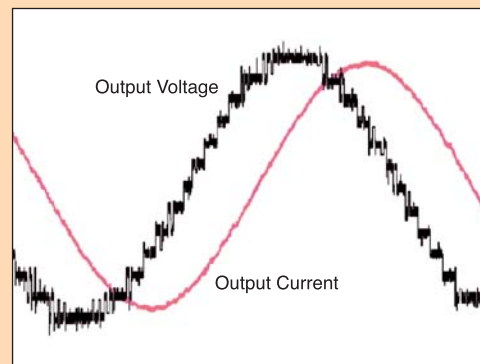
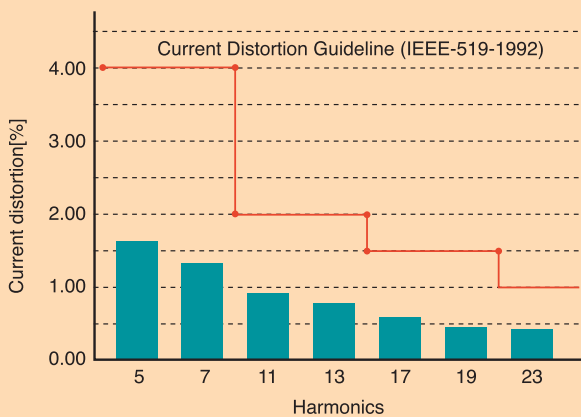
Each Inverter Cell is fed from a separate secondary winding of the isolation transformer.

These Inverter Cells are connected in series and are operated in multiplexed mode. This mode of operation generates a stepped voltage output which approximates sine waveforms. This allows the direct inverter to be used not only with new inverter motors, but with existing standard motors as well.

In addition, the phase shifted multi-winding transformer effects reduction of current harmonics to the power supply well below the levels admitted under the IEEE 519-1992 guidelines.



### Line-side current distortion content



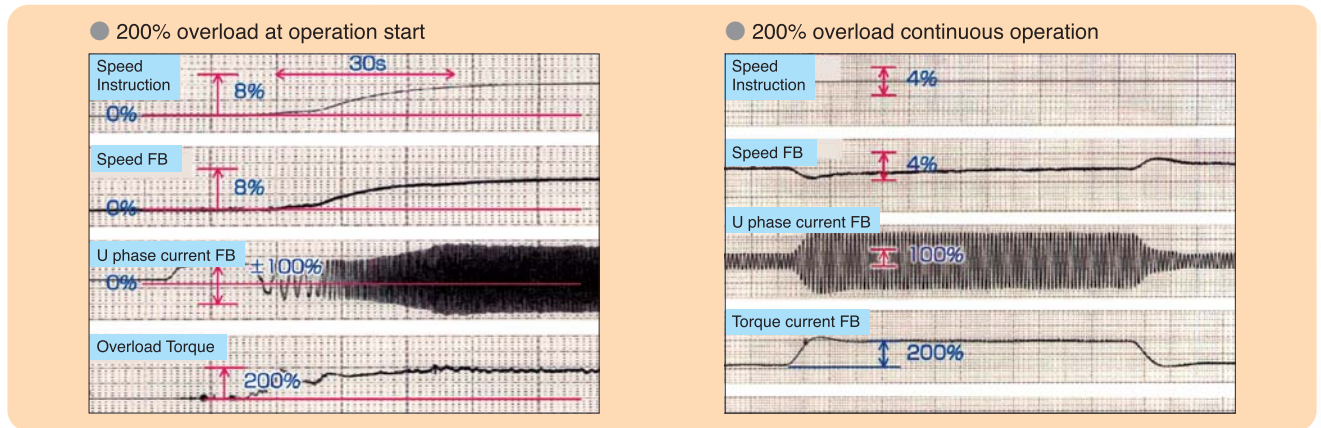
Output waveforms are very smooth resulting in reduction of electrical and mechanical stresses of the motor.

## State-of-the-art Technology and High Performance

### Best Fits for High Torque Application

Robust speed sensor-less vector control technology prevents over current conditions and operates machines in a safe and continuous mode when the impact load reaches 200%.

HIVECTOL-HVI is capable of driving a heavy starting load (200% torque) and can not only match but excel in performance compared to a DC motor. HIVECTOL-HVI best fits rubber mixers and extruders for rubber and plastic industries.

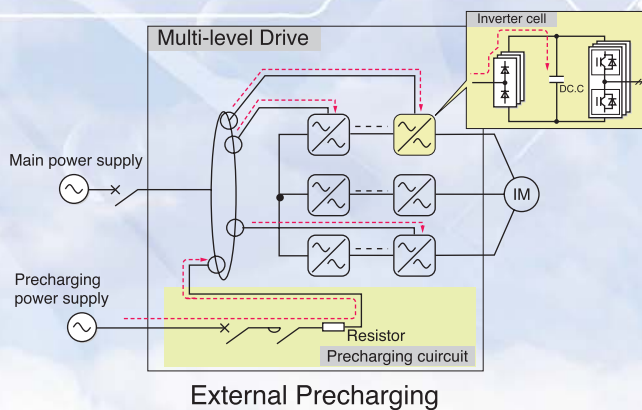


### Lower Parts Count Enhances Reliability

In order to reduce inrush current when the main power is turned on, a precharging circuit is required to charge DC capacitors. Hitachi uses its patented external precharging circuit and precharging is done by a separate power supply.

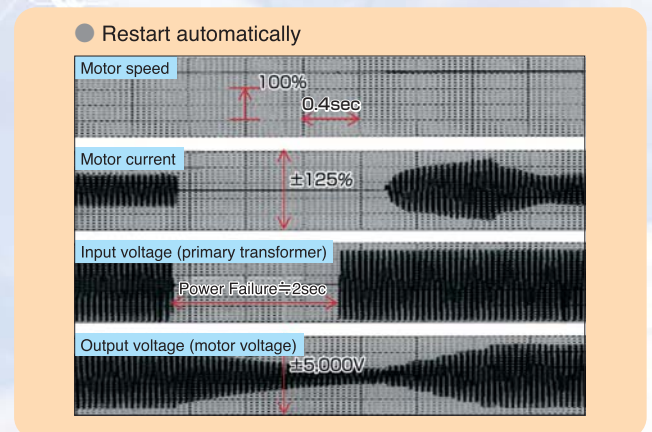
The other method is to use a precharging circuit with each Cell Inverter.

Comparing between the two precharging methods, the external precharging method is very simple and reduces the parts count.



### Automatic Restart upon Instantaneous Power Failure

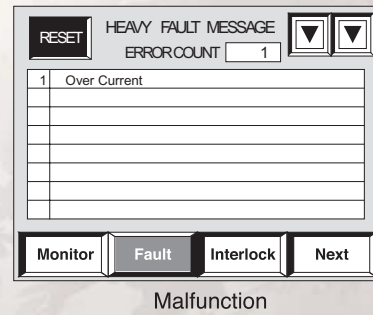
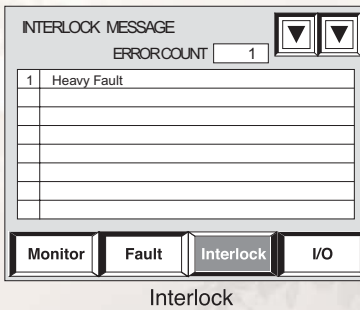
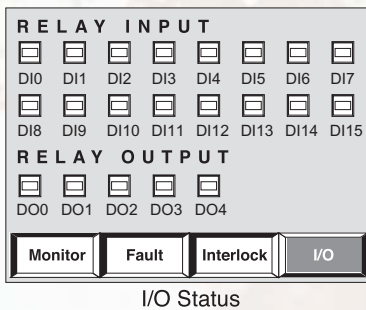
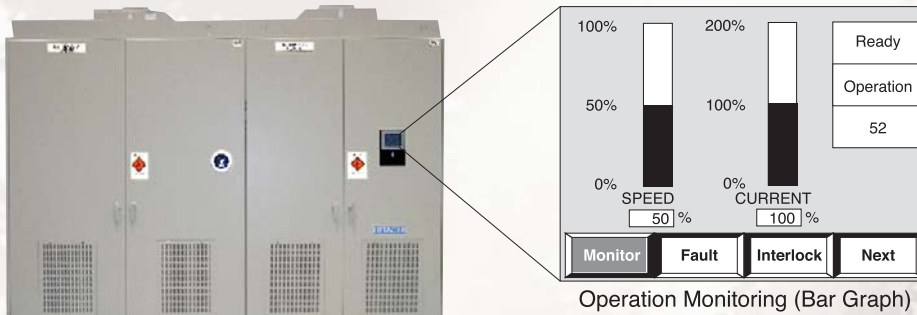
After input power recovery, the automatic restart function maintains continuous operation in the case of instantaneous power failure up to 2 seconds. The coasting motor can be reaccelerated to the reference speed automatically.



## User Friendly

### Easy Analysis and Diagnostics

The operator touch-screen panel with a large LCD is easy to see and easy to operate. Operator can see various kinds of helpful information such as the operation status and alarm information.



### Easy Maintenance

Hitachi provides a maintenance software tool which helps maintain the drive system easier. The software is designed for Windows® PC. The major functions of the maintenance tool are as follows:

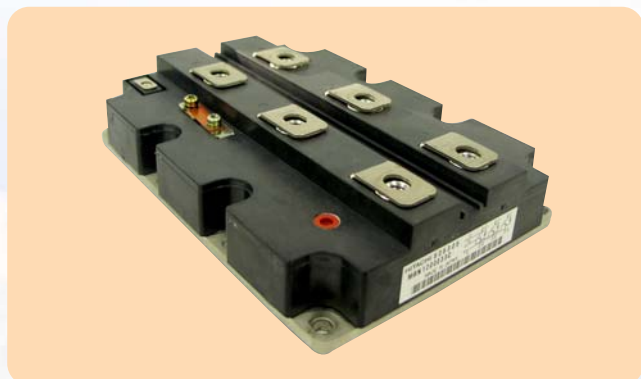
- Memory Read/Write Function
- Display Diagnostic Message and Trend Data
- Selection of Analog Output Signal
- File Read/Write Function
- Bar Graph Display Function

● Maintenance Software



## Why does HITACHI choose IGBT ?

Hitachi applies IGBT power semiconductors for all product lines of variable frequency drives. The reliability of IGBT has been proven in a variety of application environments such as steel rolling mills, traction drives, generator converters, and general purpose drives. Compared to the other types of power semiconductors, IGBT is a more commonly used power device. From this viewpoint, IGBT parts are more availability.



## Quality

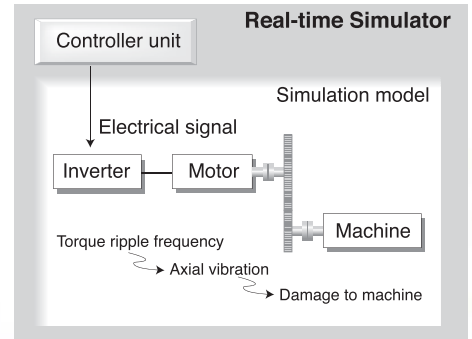
### Axial Vibration Prevention

Hitachi has developed a real-time simulator, which simulates the physical control system in real time.

The simulation models cover the main circuits of the drive motor and driven load.

For example, axial vibrations happens to be generated by resonant frequency from the load. Prior to shipment of the drives for such applications, Hitachi evaluates the resonance effect to prevent axial vibration.

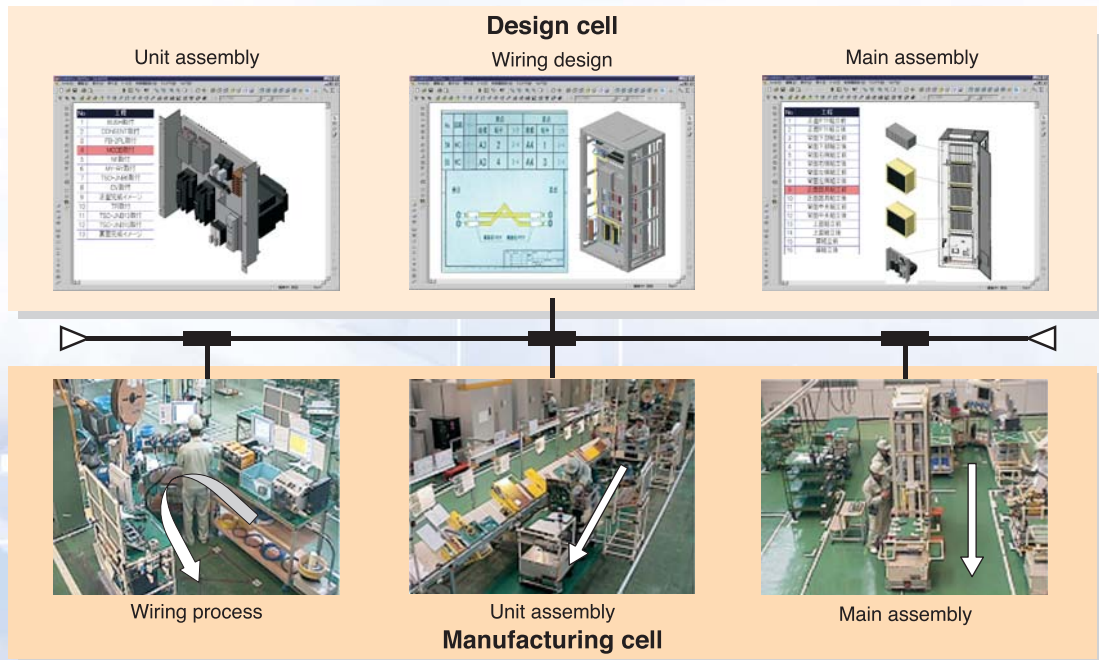
This real-time simulator works not only to improve reliability, but also to shorten the commissioning period on site.



### Quality Production

Hitachi has implemented a production data management system which displays on a video terminal the last updated or the new schematics and the Bills of Materials (BOM). Visual assistance helps

the manufacturing work force to prevent human error and to improve quality. No paper schematics are used in the wiring and assembly process.



## Remote Monitoring

Hitachi provides remote monitoring service for HIVECTOL HVI inverters.

Inverter operating conditions, alarms and diagnostic information can be monitored remotely via network connection. In the absence of customer's site engineer or service person, Hitachi service representatives can also monitor the equipment

for quality operation.

Remote monitoring enables fast response and shortens recovery time.



## HIVECTOL-HVI Specification Sheet

No.	Item		Specification											
1	HVI Rated (2.4kV)	Capacity (kVA)	360	500	720	1,090	1,450	2,180	2,900	3,630	*2			
2		Current (A)	87	122	175	262	350	525	700	875				
3		Applied Motor (kW) *1	290	400	580	870	1,160	1,740	2,320	2,900				
4	HVI Rated (3.3kV)	Capacity (kVA)	500	700	1,000	1,500	2,000	3,000	4,000	5,000				
5		Current (A)	87	122	175	262	350	525	700	875				
6		Applied Motor (kW) *1	400	560	800	1,200	1,600	2,400	3,200	4,000				
7	HVI Rated (4.16kV)	Capacity (kVA)	630	880	1,260	1,890	2,520	3,780	5,040	6,300				
8		Current (A)	87	122	175	262	350	525	700	875				
9		Applied Motor (kW) *1	500	700	1,010	1,510	2,020	3,020	4,030	5,040				
10	HVI Rated (6.6kV)	Capacity (kVA)	500	700	1,000	1,400	2,000	3,000	4,000	6,000	8,000	10,000		
11		Current (A)	44	61	87	122	175	262	350	525	700	875		
12		Applied Motor (kW) *1	400	560	800	1,120	1,600	2,400	3,200	4,800	6,400	8,000		
13	HVI-C Compact Series *3	Output Voltage (kV)	2.4	2.4	3.3	3.3	4.16	4.16	6.6	6.6				
14		Capacity (kVA)	1,820	2,180	2,500	3,000	3,150	3,780	5,000	6,000				
15		Current (A)	437	525	437	525	437	525	437	525				
16		Applied Motor (kW) *1	1,460	1,740	2,000	2,400	2,520	3,020	4,000	4,800				
17	Output	Output Voltage	AC 2,400V/3,300V/4,160V/6,600V											
18		Frequency	50/60Hz											
19	Input	Main Power Circuit	AC 2,400V/3,300V/4,160V/6,600V 3φ 50/60Hz											
20		Control/Fan Circuit	AC 200/220V 3φ 50/60Hz											
21		Volt/Freq Fluctuation	Voltage:±10% / Frequency:±5%											
22	Control Character	Main Circuit	High Voltage Direct Drive, Serial Connected Multilevel Inverter											
23		Control Method	Robust Sensorless Vector Control											
24		Running Method	Constant Acceleration, Target Value Tracking Control Method											
25		Braking Method	Natural Deceleration by Load Torque											
26		Speed Control Range	1%~100%											
27		Speed Control Accuracy	±0.5% (without speed sensor) , ±0.05% (with speed sensor(PLG)) at 100% speed											
28		Overload	125% 1min (Air Cooled)											
29		Inverter Efficiency	Approximately 97% (Including Multiplex Winding Transformer)											
30	External I/F	Input of	Analog Signal					0~±10V/4~20mA Interface						
31		Speed Reference	Field Network					Device Net, Profibus (Option)						
32	Protection	Momentary Over Current	Detected Motor Side Current											
33		Fuse	Input A.C. Side is Protected by Fuse											
34		Abnormal Output Voltage	The Output Voltage Deflection is 30% or More.											
35		Overload	125% 1min (Air Cooled)											
36		Motor Overheat	Protection by Thermo Switch (Option)											
37		Abnormal Cooling Fan	Detected by Fuse Blown or MCCB (Molded Case Circuit Breaker) Trip											
38		Power Failure	Inverter Pulses are suppressed when voltage fluctuation is -20% or less. Auto re-start (Option)											
39		Ground Fault	Detected Voltage on Neautral Grounding Point											
40	Indication	Charging	Main DC Voltage is 50V or more. Indicators are mounted on Individual Cell Inverters.											
41		Speed/Current/Fault etc.	Bar Chart / Fault Message											
42		Traceback Data	Indication of Various Control Data on Fault Occasion											
43	Structure	Cubicle	Cubicle Type											
44		Protection	IP20 (Higher degrees of protection as option)											
45	Environment	Temperature	0~40°C (Storage Temperature:-5~50°C)											
46	Standards	IEC/JIS/JEC/JEM												

\*1 : Provisional Rate in case of standard four pole motor applied.

\*2 : For the Inverter Capacity of Colored Spaces, they can be switched from the Electrolytic Capacitor to the Film Capacitor.

\*3 : HVI-C series applies Film capacitor.

## Trusted in various industrial fields

### Rubber and Plastic

Hitachi has delivered more than one hundred HIVECTOL inverters for rubber mixer drive systems to major tire manufacturers. Major tire manufacturers in the world enjoy higher productivity and profitability. Hitachi has also delivered more HIVECTOL inverters for agitators, pelletizers, extruders and more applications which require high starting torque and high intermittent torque in their operation.



### Water and Waste Water

Hitachi has delivered hundreds of drives for variable speed control of pumps in water and waste water treatment facilities.



### Metals

Hitachi has delivered hundreds of rolling mill drives all over the world. Their high reliability and performance are proven and well known in the metal industry. Hitachi has delivered a number of fan drives for energy saving in this industry.



### Oil and Gas

Replacing a mechanical drive with an AC motor drive for compressors. A motor drive is well suited for energy and maintenance cost savings and delivers better performance with precise drive control.



### Cement

HIVECTOL inverters are used not only for various fan drives but also for rotary kiln drives in the cement industry. HIVECTOL inverters help slash energy and maintenance costs.



### Thermal Power Generation

Optimization of drive speeds of ID Fans and FD Fans for boiler combustion facilities significantly save energy consumption. Hitachi has delivered HIVECTOL inverters for such applications to large utilities for many years.

### Nuclear Power Generation

Hitachi has delivered reactor internal pump drives for years. Based upon its proven drive technologies, Hitachi has developed Primary Loop Recirculation (PLR) pump drives which require extremely high reliability.



# HIVECTOR HVI

## Medium Voltage Inverter

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