

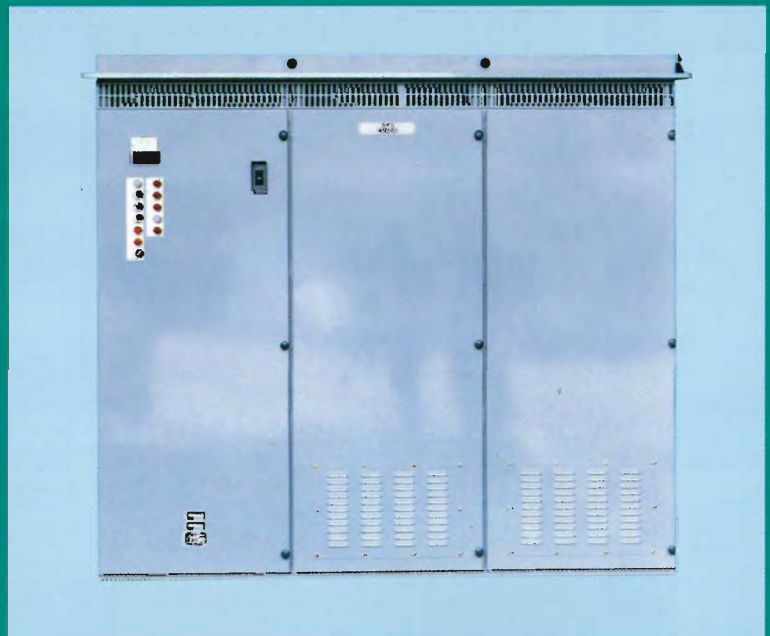
TAIYO **V**

SERIES

SUMMARY

INVERTER CONTROL SYSTEM

SYSTEM OUTPUT: 2.2KW~1,500KW



VARIABLE-VOLTAGE VARIABLE-FREQUENCY

Variable Speed of Induction Motors now become possible by changing the Voltage and Frequency with an Inverter.

- Various control systems are possible
- Revolution speed changes steplessly
- Can cope with various environments
- Promotes energy saving
- Promotes maintenance and labour saving
- Brake characteristics are available
- High speed operation is possible
- Direct in line starting is possible

FEATURE

Energy saving

By controlling revolution speed of pumps and fans, energy is saved compared to conventional valve control and damper control.

High input power factor

Power supply capacity may be reduced since high input power factors of about 95% is realized regardless of the load.

Stepless speed control

Notchless smooth operation of induction motors from 0 to maximum speed is possible since stepless control is possible with a VVVF inverter.

Easy check and easy maintenance

As induction motors are used, brush maintenance is not necessary as in DC motors. The control unit also does not require maintenance as semiconductor products are used.


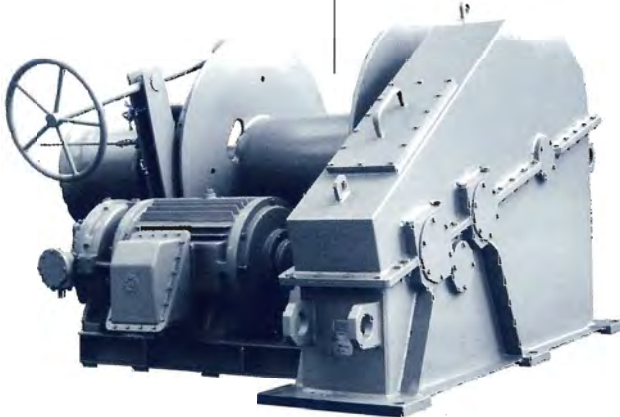
Soft start




Since soft start is carried out with an inverter, mechanical and electrical shocks on peripheral devices are softened. As peripheral environment is good which make mechanical troubles decrease and life is extended.

STANDARD SPECIFICATIONS

Equipment output	2.2 KW ~ 1,500 KW
Voltage	440 V
Frequency	60 Hz
Phase	3 Phase 3 Wires
Rating	Continuous
Revolution speed	± (5 ~ 200%)
(± 300% is possible if the basic frequency of the motor is changed)	

ADVANTAGES BY VVVF INVERTER

Model & Usage	Conventional system	Effects of VVVF INVERTER
Model : VCW For M/E cooling water pump 	1) Not suitable for main engine as the pump motor is a constant speed type and main engine tends to become too cold. 2) Although there are types in which temperature is kept constantly through recirculating circuit, there is no energy saving. Separate power will become necessary.	1) Desirable for the main engine as temperature of the main engine cooling water is automatically controlled. 2) Large energy saving is realized since electric power for C. W. pump motor is dropped by a triple ratio of its revolution. 3) Good controllability and easy remote control can be achieved. 4) It will also be possible to install one VVVF INVERTER for two M / E cooling water pumps and use by switching over. (will result in low cost)
Model : VWM For Windlass and Mooring winch 	1) Undesirable in the case of pole change motor because of the electrical and mechanical shocks when starting or changing poles. 2) Hydraulic equipment will be required in addition to electric in the case that hydraulic system is used. 3) Not suitable for passenger cruiser or ferry that cleanliness and low noise is desired.	1) No mechanical or electrical shocks since starting is soft and change is smooth. Life of the machine will also be extended. 2) Electricity alone is required for power, workability of electric wiring is generally good, construction is simple and change of system and circuits is easy. 3) Suitable for high class ships since it operates cleanly with less noise. 4) High speed operation (three time) is also possible with good controllability and operability. It is also suitable for low speed operation such as when storing the anchor. 5) VVVF INVERTER has the four quadrant modes of forward powering, reverse powering, forward regenerating and reverse regenerating. The regenerating mode returns electric power to the power supply and acts as a brake to reduce rotation. This regenerative brake acts to improve stopping performance.

Model & Usage	Conventional system	Effects of VVVF INVERTER
Model : VFD For Forced Draft Fan 	1) As air volume is controlled by minute opening and closing of the vane, there are mechanical sliding parts that require maintenance, and power other than electricity is also required. 2) Large generator is required because of the large starting current of the fan motor. 3) As the fan motor rotates at a constant speed, there is no energy saving.	1) Maintenance free because there are no mechanical sliding parts such as vanes since air volume control is by means of speed control by VVVF INVERTER. As power is electricity alone, piping is not required. 2) Generator capacity may be kept small even for the case of large motor as soft start is possible with VVVF INVERTER. 3) Large energy saving is realized as electric power for the FD fan is dropped by a triple ratio of its revolutions.
Model : VCO For Cargo oil pump 	1) Large generator is required because of the large starting current of the cargo oil pump motor. 2) There is no energy saving as the revolution of the cargo oil pump motor is constant.	1) Generator capacity may be kept small even for the case of large motor as soft start is possible with VVVF INVERTER. 2) Large energy saving is realized as electric power for the cargo oil pump motor is dropped by a triple ratio of its revolution.
Model : VTR For Thruster 	1) Start compensating device is required because of the large starting current. 2) Aux. equipment such as hydraulic equipment is required to control CPP for constant-speed motors.	1) As soft start is possible, a start compensating device is not required. 2) As rotation speed is controlled by VVVF INVERTER, FPP is sufficient for propeller and separate power is not required. 3) Large energy saving is realized as electric power for the thruster motor is dropped by a triple ratio of its revolution.

OTHER USAGE OF VVVF INVERTER

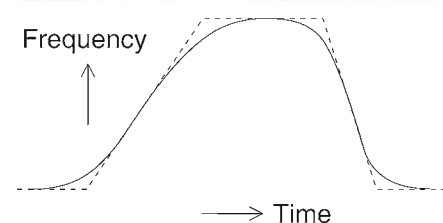
- Main Circulating Pump** : Energy saving effects by flow control of on-board ship load.
- Low Duty Gas Compressor** : Maintenance free compared to the conventional thyristor leonard system because of constant control of internal pressure of the boiler drum.
- Heavy F. O. Purifier Feed Pump** : Constant control of internal oil level of tank (Operability).
- Diesel Oil Purifier Feed Pump** : Constant control of internal oil level of tank (Operability).
- Stripping Pump** : Variable speed control of pump corresponding to oil level in the cargo oil tank (Operability, remote operation).
- Motor-Generator Set** : Maintenance free compared to M-G set driven by DC motor.

CHARACTERISTICS

VARIETY OF FUNCTIONS

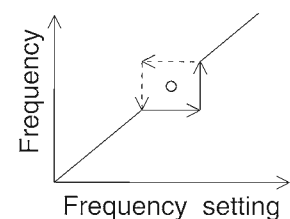
Many functions can be selected with internal settings of the VVVF inverter. Several examples are shown as below.

S-Function Acceleration/Deceleration



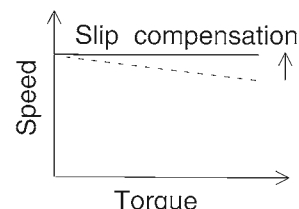
Smooth shockless speed change characteristics can be obtained.
(Note: Individual variable speed time can naturally be set.)

Frequency Jump



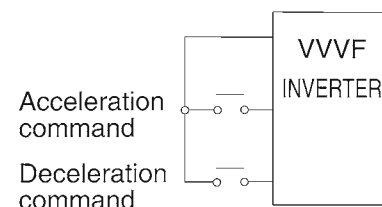
Resonant frequency can be jumped when operation to avoid resonance of machines and structures is desired.
(Note: Jumping places shall be three.)

Slip Compensation

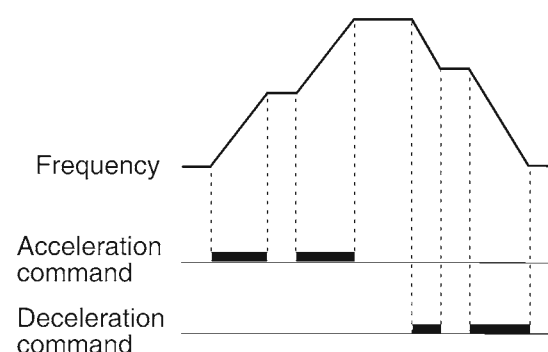


Slip compensation is possible without the need to detect motor speed.

Interlock Frequency setting



Rise and fall of the output frequency can be controlled by external contact signals.

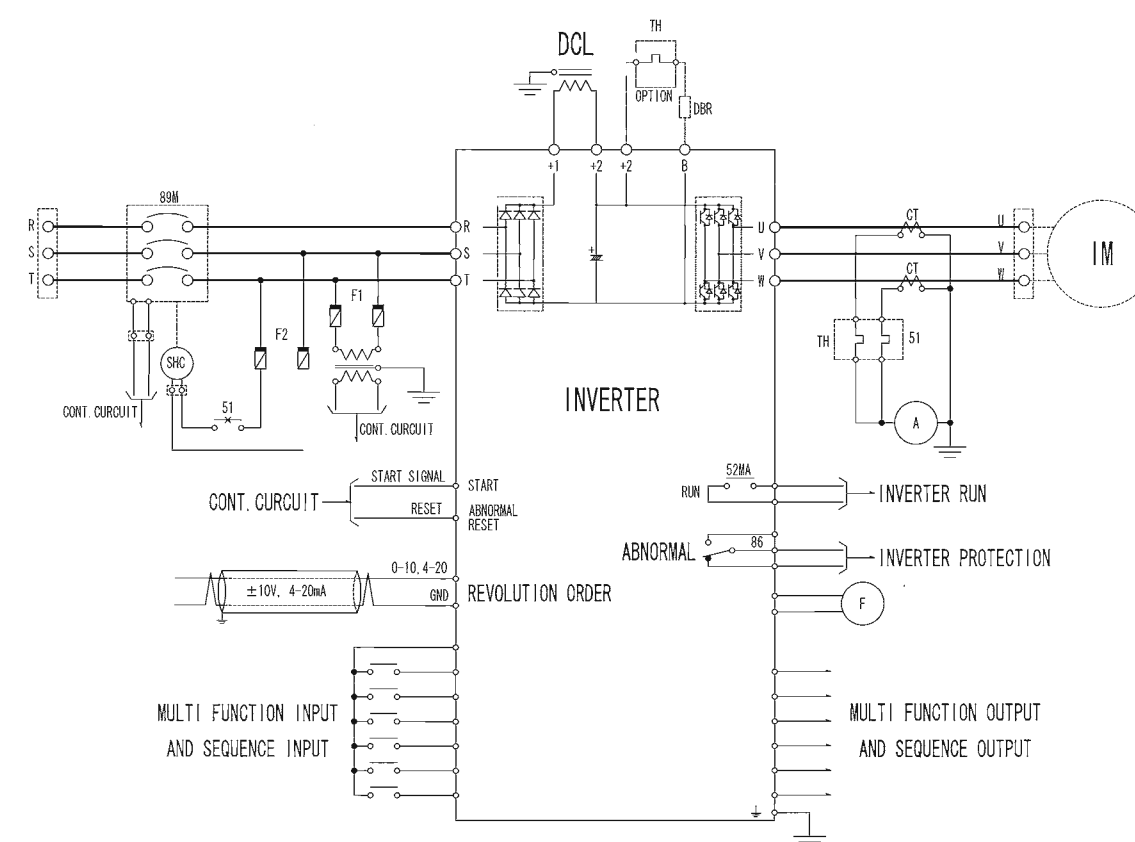


PROTECTIVE FUNCTIONS

- Over-load** : Stops if a current of over 150% flows continuously for over one minute. (Working current setting possible)
- Over-current** : Stops if abnormal current flows such as from a short circuit in the motor.
- Over-voltage** : Stops if intermediate DC voltage becomes overvoltage such as from abnormal regenerating.
- Over-frequency** : Stops if frequency exceeds the set value. (Optional setting of the operating frequency is possible)
- Over-heat of fin** : Stops with overheating of the semi-conductor cooling fin.
- Fuse open** : Stops with open fuse in the intermediate DC circuit.
- Low voltage and power failure detection** : Stops if the AC input voltage continues for over 15 msec at under 80% of the rated value.
(However, automatic restart with return of power is possible)
- Current limiting** : If overload occurs during acceleration, deceleration or constant speed operation of the motor, overload is prevented by controlling torque.

Abnormality of control auxiliary power supply, ROM and RAM check sum abnormality, battery abnormality and etc. can be also monitored.

BASIC DIAGRAM



ACCESSORIES

Air Filter

OPTIONAL ACCESSORIES

Current input circuit	: Used when controlling from externally with 4 mA to 20 mA signals.
Generative braking circuit and resistor	: Used when speeding up deceleration time by applying deceleration torque.
Motor guard	: Used to protect against overheating of the motor stator winding.
Manual frequency setter	: Used when setting revolutions by manual.
Line filter	: Used to remove noise generated from the inverter.
Regenerative braking circuit	: Used in the case of continuous large back power.
Automatic speed control circuit	: Corrects slippage by load when carrying out more accurate speed control.

STANDARD SPARE PARTS

Fuse

Fan

OPTIONAL SPARE PARTS

Complete set of printed circuit boards