9

Troubleshooting

This chapter describes the fault displays and countermeasure for the VG5 and motor problems and countermeasures.

9.1 Protective and Diagnostic Functions

9.1.1 Fault Detection

When the Inverter detects a fault, the fault code is displayed on the Digital Operator, the fault contact output operates, and the Inverter output is shut OFF causing the motor to coast to a stop. (The stopping method can be selected for some faults, and the selected stopping method will be used with these faults.)

- When a fault has occurred, refer to the following table to identify and correct the cause of the fault.
- Use one of the following methods to reset the fault after restarting the Inverter.
  - Turn ON the fault reset signal.
    (A multi-function input (H1-01 to H1-06) must be set to 14 (Fault Reset).)
  - Press the RESET key on the Digital Operator.
  - Turn the main circuit power supply off and then on again.

Table 9.1 Fault Displays and Processing

Fault Display	Meaning	Probable Causes	Corrective Actions
OC Overcurrent	Overcurrent The Inverter output current exceeded the overcurrent detection level. (200% of rated current)	• A short-circuit or ground fault occurred at the Inverter output. (A short or ground fault can be caused by motor burn damage, worn insulation, or a damaged cable.) • The load is too large or the acceleration/deceleration time is too short. • A special-purpose motor or motor with a capacity too large for the Inverter is being used. • A magnetic switch was switched at the Inverter output.	Reset the fault after correcting its cause.
GF Ground Fault	Ground Fault The ground fault current at the Inverter output exceeded approximately 50% of the Inverter rated output current.	A ground fault occurred at the Inverter output. (A ground fault can be caused by motor burn damage, worn insulation, or a damaged cable.)	Reset the fault after correcting its cause.
PUF DC Bus Fuse Open	Fuse Blown The fuse in the main circuit is blown.	The output transistor has failed because of a short-circuit or ground fault at the Inverter output. Check whether there is a short-circuit between the following terminals. A short-circuit will damage the output transistor: B1 (⊕ 3) ↔U, V, W √ ↔ U, V, W	Replace the Inverter after correcting the cause.
SC Short Circuit	Load Short-Circuit The Inverter output or load was short-circuited.	A short-circuit or ground fault occurred at the Inverter output. (A short or ground fault can be caused by motor burn damage, worn insulation, or a damaged cable.)	Reset the fault after correcting its cause.
OV Overvoltage	Main Circuit Overvoltage The main circuit DC voltage exceeded the overvoltage detection level. 200 V class: Approx. 400 V 400 V class: Approx. 800 V	The deceleration time is too short and the regenerative energy from the motor is too large.	Increase the deceleration time or connect a braking resistor (or Braking Resistor Unit).
		The power supply voltage is too high.	Decrease the voltage so it is within specifications.
UV1 DC Bus Undervolt	Main Circuit Undervoltage The main circuit DC voltage is below the undervoltage detection level (L2-05). 200 V class: Approx. 190 V 400 V class: Approx. 380 V	• An open-phase occurred with the input power supply. • A momentary power loss occurred. • The wiring terminals for the input power supply are loose. • The voltage fluctuations in the input power supply are too large.	Reset the fault after correcting its cause.
UV2 CTL PS Undervolt	Control Power Fault The control power supply voltage dropped.	—	• Try turning the power supply off and on. • Replace the Inverter if the fault continues to occur.
UV3 MC Answerback	Inrush Prevention Circuit Fault A fault occurred in the inrush prevention circuit.	—	• Try turning the power supply off and on. • Replace the Inverter if the fault continues to occur.

Fault Display	Meaning	Probable Causes	Corrective Actions
PF Input Pha Loss	Main Circuit Voltage Fault The main circuit DC voltage oscillates unusually (not when regenerating). This fault is detected when L8-05 is set to "Enabled."	• An open-phase occurred in the input power supply. • A momentary power loss occurred. • The wiring terminals for the input power supply are loose. • The voltage fluctuations in the input power supply are too large. • The voltage balance between phases is bad.	Reset the fault after correcting its cause.
LF Output Pha Loss	Output Open-Phase An open-phase occurred at the Inverter output. This fault is detected when L8-07 is set to "Enabled."	• There is a broken wire in the output cable. • There is a broken wire in the motor winding. • The output terminals are loose	Reset the fault after correcting its cause.
OH (OH1) Heatsink Over tmp	Cooling Fin Overheating The temperature of the Inverter's cooling fins exceeded the setting in L8-02 or 105°C.	The ambient temperature is too high.	Install a cooling unit.
		There is a heat source nearby.	Remove the heat source.
		The Inverter's cooling fan has stopped.	Replace the cooling fan. (Contact your Saftronics representative.)
RH Dyn Brk Resistor	Installed Braking Resistor Overheating The Braking Resistor is overheated and the protection function set with L8-01 has operated.	The deceleration time is too short and the regenerative energy from the motor is too large.	• Reduce the load, increase the deceleration time, or reduce the motor speed. • Change to a Braking Resistor Unit.
RR Dyn Brk Transistr	Internal Braking Transistor Fault The braking transistor is not operating properly.	—	• Try turning the power supply OFF and ON. • Replace the Inverter if the fault continues to occur.
OL1 Motor Overloaded	Motor Overloaded The motor overload protection function has operated based on the internal electronic thermal value.	The load is too heavy. The acceleration time, deceleration time, and cycle time are too short.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
		The V/f characteristics voltage is too high.	Check the V/f characteristics.
		The motor's rated current setting (E2-01) is incorrect.	Check the motor's rated current setting (E2-01).
OL2 Inv Overloaded	Inverter Overload The Inverter overload protection function has operated based on the internal electronic thermal value.	The load is too heavy. The acceleration time, deceleration time, and cycle time are too short.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
		The V/f characteristics voltage is too high.	Check the V/f characteristics.
		The Inverter capacity is too low.	Replace the Inverter with one that has a larger capacity.
OL3 Overtorque Det 1	Overtorque 1 There has been a current greater than the setting in L6-02 for longer than the setting in L6-03.	—	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
OL4 Overtorque det 2	Overtorque 2 There has been a current greater than the setting in L6-05 for longer than the setting in L6-06.	—	• Make sure that the current setting in L6-05 and time setting in L6-06 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
OS Over speed	Overspeed The speed has been greater than the setting in F1-08 for longer than the setting in F1-09.	Overshooting/Undershooting are occurring.	Adjust the gain again.
		The reference speed is too high.	Check the reference circuit and reference again.
		The settings in F1-08 and F1-09 are not appropriate.	Check the settings in F1-08 and F1-09.

Fault Display	Meaning	Probable Causes	Corrective Actions
PGO PG open	PG Disconnection Detected The PG is disconnected. The Inverter is outputting a frequency, but PG pulses are not being input.	There is a break in the PG wiring.	Fix the broken/disconnected wiring.
		The PG is wired incorrectly.	Fix the wiring.
		Power is not being supplied to the PG.	Supply power to the PG properly.
		—	Check for open circuit when using brake (motor).
DEV Speed Deviation	Excessive Speed Deviation The Speed Deviation has been greater than the setting in F1-10 for longer than the setting in F1-11.	The load is too heavy.	Reduce the load.
		The acceleration time and deceleration time are too short.	Lengthen the acceleration time and deceleration time.
		The load is locked.	Check the mechanical system.
		The settings in F1-10 and F1-11 are not appropriate.	Check the settings in F1-10 and F1-11.
		—	Check for open circuit when using brake (motor).
CF Out of Control	Control Fault The torque limit was reached continuously for 3 seconds or longer during a deceleration stop during Open-Loop Vector Control.	—	Check the motor constants.
SVE Zero Servo Fault	Zero Servo Fault The rotation position moved during Zero Servo operation.	The torque limit is too small.	Increase the limit.
		The load torque is too large.	Reduce the load torque.
		—	Check for signal noise.
OPR Oper Disconnect	Operator Connection Fault The Operator was disconnected during operation started by a run command from the Operator.	—	Check the Operator connection.
EFO Opt External Flt	External fault input from Transmission Option Card.	—	Check the Transmission Option Card and transmission signal.
EF3 External Fault 3	External fault (input Terminal 3)	An “external fault” was input from a multi-function input.	• Reset external fault inputs to the multi-function inputs. • Remove the cause of the external fault.
EF4	External fault (input Terminal 4)		
EF5	External fault (input Terminal 5)		
EF6	External fault (input Terminal 6)		
EF7	External fault (input Terminal 7)		
EF8	External fault (input Terminal 8)		
CPF00 COM-ERR (OP&INV)	Operator Communications Error 1 Communications with the Operator were not established within 5 seconds after the power was turned ON.	The Digital Operator’s connector is not connected properly.	Disconnect the Digital Operator and then connect it again.
		The Inverter’s control circuits are faulty.	Replace the Inverter.
CPF01 COM-ERR (OP&INV)	Operator Communications Error 2 After communications were established, there was a transmission error with the Digital Operator for more than 2 seconds.	The Digital Operator is not connected properly	Disconnect the Digital Operator and then connect it again.
		The Inverter’s control circuits are faulty.	Replace the Inverter.
CPF02 BB Circuit Err	Baseblock circuit error.	—	Try turning the power supply OFF and ON again.
		The control circuit is damaged.	Replace the Inverter.

Fault Display	Meaning	Probable Causes	Corrective Actions
CPF03 EEPROM Error	EEPROM error	—	Try turning the power supply OFF and ON again.
		The control circuit is damaged.	Replace the Inverter.
CPF04 Internal A/D Err	CPU internal A/D converter error	—	Try turning the power supply OFF and ON again.
		The control circuit is damaged.	Replace the Inverter.
CPF05 External A/D Err	CPU external A/D converter error	—	Try turning the power supply OFF and ON again.
		The control circuit is damaged.	Replace the Inverter.
CPF06 Option Error	Option Card connection error	The Option Card is not connected properly.	Turn off the power and insert the Card again.
		The Inverter or Option Card is faulty.	Replace the faulty component.
CPF20 Option A/D Error	Option Card A/D converter error	The Option Card is not connected properly.	Turn OFF the power and insert the Card again.
		The Option Card's A/D converter is faulty.	Replace the Option Card.
CPF21 Option CPU down	Transmission Option Card self diagnostic error	Option Card fault.	Replace the Option Card.
CPF22 Option Type Err	Transmission Option Card model code error		
CPF23 Option DPRAM Err	Transmission Option Card DPRAM error		

9.1.2 Minor Fault Detection

Minor faults are a type of Inverter protection function that do not operate the fault contact output and are automatically returned to their original status once the cause of the minor fault has been removed.

The Digital Operator display blinks and the minor fault is output from the multi-function outputs (H2-01 to H2-03).

Take appropriate countermeasures according to the table below.

Table 9.2 Minor Fault Displays and Processing

Minor Fault Display	Meaning	Probable Causes	Corrective Actions
EF (blinking) External Fault	Forward/Reverse Run Commands Input Together Both the forward and reverse run commands have been ON for more than 0.5 seconds.	—	Check the sequence of the forward and reverse run commands. Since the rotational direction is unknown, the motor will be decelerated to a stop when this minor fault occurs.
UV (blinking) DC Bus Undervolt	Main Circuit Undervoltage The following conditions occurred when there was no Run signal: • The main circuit DC voltage was below the undervoltage detection level (L2-05). • The surge current limiting contactor opened. • The control power supply voltage when below the CUV level.	See causes for UV1, UV2, and UV3 faults.	See corrective actions for UV1, UV2, and UV3 faults.
OV (blinking) Overvoltage	Main Circuit Overvoltage The main circuit DC voltage exceeded the overvoltage detection level. 200 V class: Approx. 400 V 400 V class: Approx. 800 V	The power supply voltage is too high.	Decrease the voltage so it is within specifications.
OH (blinking) Heatsink Over tmp	Cooling Fin Overheating The temperature of the Inverter's cooling fins exceeded the setting in L8-02.	The ambient temperature is too high.	Install a cooling unit.
		There is a heat source nearby.	Remove the heat source.
		The Inverter cooling fan has stopped.	Replace the cooling fan. (Contact your Saftronics representative.)

Minor Fault Display	Meaning	Probable Causes	Corrective Actions
OH2 (blinking) Over Heat 2	Inverter Overheating Pre-alarm An OH2 alarm signal (Inverter overheating alarm signal) was input from a multi-function input.	—	Clear the multi-function input's overheating alarm input.
OL3 (blinking) Overtorque Det 1	Overtorque 1 There has been a current greater than the setting in L6-02 for longer than the setting in L6-03.	—	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
OL4 (blinking) Overtorque Det 2	Overtorque 2 There has been a current greater than the setting in L6-05 for longer than the setting in L6-06.	—	• Make sure that the current setting in L6-05 and time setting in L6-06 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
OS (blinking) Over speed	Overspeed The speed has been greater than the setting in F1-08 for longer than the setting in F1-09.	Overshooting/undershooting are occurring.	Adjust the gain again.
		The reference speed is too high.	Check the reference circuit and reference again.
		The settings in F1-08 and F1-09 are not appropriate.	Check the settings in F1-08 and F1-09.
PGO (blinking) PG open	The PG is disconnected The Inverter is outputting a frequency, but PG pulses are not being input.	There is a break in the PG wiring.	Fix the broken/disconnected wiring.
		The PG is wired incorrectly.	Fix the wiring.
		Power is not being supplied to the PG.	Supply power to the PG properly.
DEV (blinking) Speed Deviation	Excessive Speed Deviation The speed deviation has been greater than the setting in F1-10 for longer than the setting in F1-11.	The load is too large.	Reduce the load.
		The acceleration time and deceleration time are too short.	Lengthen the acceleration time and deceleration time.
		The load is locked.	Check the mechanical system.
		The settings in F1-10 and F1-11 are not appropriate.	Check the settings in F1-10 and F1-11.
EF3 (blinking) External Fault 3	External fault (Input Terminal 3)	An "external fault" was input from a multi-function input.	• Reset external fault inputs to the multi-function inputs. • Remove the cause of the external fault.
EF4 (blinking)	External fault (Input Terminal 4)		
EF5 (blinking)	External fault (Input Terminal 5)		
EF6 (blinking)	External fault (Input Terminal 6)		
EF7 (blinking)	External fault (Input Terminal 7)		
EF8 (blinking)	External fault (Input Terminal 8)		
CE MEMOBUS Com Err	Communications Error Normal reception was not possible for 2 seconds after received control data.	—	Check the communications devices and signals.
BUS Option Com Err	Option Card Transmission Error A communications error occurred in a mode where the run command or a frequency reference is set from a Transmission Option Card.	—	Check the Transmission Card and signals.
CALL Serial Com Call	SI-B Communications Error Control data was not normally received when power was turned ON.	—	Check the communications devices and signals.
E-15 SI-F/G Com Err	SI-F/G Communications Error Detected A communications error occurred in a mode where run or a frequency reference is set from a Transmission Option Card and E-15 I set to continue operation.	—	Check the communications devices and signals.
EF0 Opt External Flt	DDS/SI-B External Error Detected An external error was received from an Option Card when EF0 was set to continue operation.	—	Remove the cause of the external error.

9.1.3 Operation Errors

After the constants have been set, an operation error will occur if there is an invalid setting or a contradiction between two constants settings.

It will not be possible to start the Inverter until the constants have been set correctly. (The minor fault output and fault contract output will not operate either.)

When an operation error has occurred, refer to the following table to identify and correct the cause of the errors.

Table 9.3 Operation Error Displays and Incorrect Settings

Display	Meaning	Incorrect settings
OPE01 KVA Selection	Incorrect Inverter capacity setting	The Inverter capacity setting does not match the Unit. (Contact your Saftronics representatives.)
OPE02 Limit	Constant setting range error	The constant setting is outside of the valid setting range.
OPE03 Terminal	Multi-function input selection error	One of the following errors has been made in the multi-function input (H1-01 to H1-06) settings: • The same setting has been selected for two or more multi-function inputs. • An up or down command was selected independently. (They must be used together.) • The up/down commands (10 and 11) and Accel/Decel Ramp Hold (A) were selected at the same time. • Speed Search 1 (61, maximum output frequency) and Speed Search 2 (62, set frequency) were selected at the same time. • External Baseblock NO (8) and External Baseblock NC (9) were selected at the same time. • The up/down commands (10 and 11) were selected while PID Control (b5-01) was enabled. • The Terminal 13/14 Switch (1F) was selected, but the Terminal 14 function selector (H3-09) was not set to frequency reference (1F).
OPE05 Sequence Select	Option Card selection error	The Option Card was selected as the frequency reference source by setting b1-01 to 3, but an Option Card is not connected.
OPE06 PG Opt Missing	Control method selection error	• V/f Control with PG Feedback was selected by setting A1-02 to 1, but a PG /Speed Control Card is not connected. • Flux Vector Control was selected by setting A1-02 to 3, but a PG Speed Option Card is not connected.
OPE07 Analog Selection	Multi-function analog input selection error	• The same setting (other than 1F) has been selected for H3-05 and H3-09. • An A1-14B Analog Reference Card is being used and F2-01 is set to 0, but a multi-function input (H1-01 to H1-06) has been set to Option/Inverter Selection (2).
OPE08 Elevator Table	Constant selection error	A setting has been made that is not required in the current control method. Ex.: A function used only with flux vector control was selected for Open-Loop Vector Control.
OPE10 V/f Ptrn Setting	V/f data setting error	Constants E1-04, E1-06, E1-07, and E1-09 do not satisfy the following conditions: • E1-04 (FMAX) $\geq$ E1-06 (FA) > E1-07 (FB) $\geq$ E1-09 (FMIN)
OPE11 CarrFrg/On-Delay	Constant setting error	One of the following constant setting errors exists: • The carrier frequency upper limit (C6-01) > 5 KHz and the carrier frequency lower limit (C6-02) $\leq$ 5 KHz. • The carrier frequency gain (C6-03) > 6 and (C6-01) > (C6-02). • Upper/lower limit error in C6-01 to 03 or C8-15.
ERR EEPROM R/W Err	EEPROM write error	A verification error occurred when writing EEPROM. • Try turning the power supply OFF and on again. • Try setting the constants again.

9.2 Troubleshooting

Due to constant setting errors, faulty wiring, and so on, the Inverter and motor may not operate as expected when the system is started up. If that should occur, use this section as a reference and apply the appropriate measures.

If the contents of the fault are displayed, refer to 9.1 *Protective and Diagnostic Functions.*

9.2.1 If Constant Constants Cannot Be Set

■ The display does not change when the Increment and Decrement keys are pressed.

1. Passwords do not match. (Only when a password is set.)
   - If the constant A1-04 (Password 1) and A1-05 (Password 2) numbers are different, the constants for the Initialize mode cannot be changed. Reset the password.
   - If you cannot remember the password, display A1-05 (select password) by pressing the Reset/Select key and the Menu key simultaneously while in the A1-04 display. Then reset the password. (Input the reset password in constant A1-04.)
2. Constant write enable is input.
   - This occurs when "constant write enable" (set value: 1B) is set for a multi-function input. If the constant write enable input is OFF, the constants cannot be changed. Turn it ON and then set the constants.
3. The Inverter is operating (Drive mode).
   - There are some constants that cannot be set during operation. Turn the Inverter off and then make the settings.

■ OPE01 through OPE11 is displayed.

- This is a constant setting error. The set value for the constant is wrong. Refer to 9.1.3 *Operation Errors* and correct the setting.

■ CPF00 or CPF01 is displayed.

- This is a Digital Operator communications error. The connection between the Digital Operator and the Inverter may be faulty. Remove the Digital Operator and the re-install it.

9.2.2 If the Motor does Not Operate

■ The motor does not operate when the Run key on the Digital Operator is pressed.

1. The operating method setting is wrong.
   - If constant b1-02 (run source) is set to "1" (control circuit terminal), the motor will not operate when the Run key is pressed. Either press the LOCAL/REMOTE key* to switch to Digital Operator operation or set constant b1-02 to "0" (Digital Operator).

     The LOCAL/REMOTE key is enabled (set value: 1) or disabled (set value: 2) by means of constant o2-01. It is enabled when the drive mode is entered.
2. The Inverter is not in Operation mode.
   - If the Inverter is not in drive mode, it will remain in ready status and will not start. Press the Menu key to display the Operation mode, and enter the drive mode by pressing the Enter key.
3. The frequency reference is too low.
   - If the frequency reference is set below the frequency set in E1-09 (minimum output frequency), the Inverter will not operate. Raise the frequency reference to at least the minimum output frequency. (Related constant: b1-05.)
4. There is a multi-function analog input setting error.
   - If multi-function analog inputs H3-05 and H3-09 are set to "1" (frequency gain), and if no voltage (current) is input, then the frequency will be zero. Check to be sure that the set value and analog input value are correct.

5. Frequency reference 2 is specified with multi-step speed operation, and auxiliary frequency reference is not input.

   - If multi-function analog input H3-05 is set to “0” (auxiliary frequency reference), and if multi-step speed reference is used, the auxiliary frequency reference will be treated as frequency reference 2. Check to be sure that the set value and analog input value (Terminal 16) are correct.

6. A digital setting was made for frequency reference 2 for multi-step speed operation, but “1F” was not set for a multi-function analog input (H3-05).

   - The auxiliary frequency reference is treated as frequency reference 2 when the multi-step speed references are used and “0” (auxiliary frequency reference) is set for the multi-function analog input (H3-05).

   - Make sure that “1F” is set for the multi-function analog input (H3-05) and that the setting of frequency reference 2 is appropriate.

■ The motor does not operate when an external operation signal is input.

1. The operation method selection is wrong.

   - If constant b1-02 (run source) is set to “0” (Digital Operator), the motor will not operate when an external operation signal is input. Set b1-02 to “1” (control circuit terminal) and try again.

   - Similarly, the motor will also not operate if the LOCAL/REMOTE key has been pressed to switch to Digital Operator operation. In that case press the LOCAL/REMOTE key* again to return to the original setting.

     * The LOCAL/REMOTE key is enabled (set value: 1) or disabled (set value: 2) by means of constant o2-01. It is enabled when Drive mode is entered.

2. A 3-wire sequence is in effect.

   - The input method for a 3-wire sequence is different than when operating by forward/stop and reverse/stop (2-wire sequence). When 3-wire sequence is set, the motor will not operate even when an input terminal suitable for forward run/stop and reverse run/stop is turned ON.

   - When using a 3-wire sequence, refer to the timing chart on Page 108 and input the proper signals.

   - When using a 2-wire sequence, set multi-function inputs H1-01 through H1-06 to a value other than 0.

3. The Inverter is not in Operation mode.

   - If the Inverter is not in Operation mode, it will remain in ready status and will not start. Press the Menu key to display the Drive mode, and enter the drive mode by pressing the Enter key.

4. The frequency reference is too low.

   - If the frequency reference is set below the frequency set in E1-09 (minimum output frequency), the Inverter will not operate.

   - Raise the frequency reference to at least the minimum output frequency. (Related constant: b1-05.)

5. There is a multi-function analog input setting error.

   - If multi-function analog inputs H3-05 and H3-09 are set to “1” (frequency gain), and if no voltage (current) is input, then the frequency reference will be zero. Check to be sure that the set value and analog input value are correct.

6. Frequency reference 2 is specified with multi-step speed operation and auxiliary frequency reference is not input.

   - If multi-function analog input H3-05 is set to “0” (auxiliary frequency reference) and if multi-step speed reference is used, the auxiliary frequency reference will be treated as frequency reference 2. Check to be sure that the set value and analog input value (Terminal 16) are correct.

7. A digital setting was made for frequency reference 2 for multi-step speed operation, but “1F” was not set for a multi-function analog input (H3-05).

   - The auxiliary frequency reference is treated as frequency reference 2 when the multi-step speed references are used and “0” (auxiliary frequency reference) is set for multi-function analog input (H3-05).

   - Make sure that “1F” is set for the multi-function analog input (H3-05) and that the setting of frequency reference 2 is appropriate.

■ The motor stops during acceleration or when a load is connected.

- The load may be too heavy. The Inverter has a Stall Prevention function and an automatic torque boost function, but the motor responsiveness limit may be exceeded if acceleration is too rapid or if the load is too heavy. Lengthen the acceleration time or reduce the load. Also consider increasing the motor capacity.

■ The motor only rotates in one direction.

- "Reverse run prohibited" is selected. If b1-04 (prohibition of reverse operation) is set to "1" (reverse run prohibited), the Inverter will not receive reverse run commands. To use both forward and reverse operation, set b1-04 to "0".

9.2.3 If the Direction of the Motor Rotation is Reversed

- The motor output wiring is faulty. When the Inverter T1, T2, and T3 (U, V, and W) are properly connected to the motor T1, T2, and T3 (U, V, and W), the motor operates in a forward direction when a forward run command is executed. The forward direction depends on the manufacturer and the motor type, so be sure to check the specifications. Switching two wires among the T1, T2, and T3 (U, V, and W) will reverse the direction of rotation.

9.2.4 If the Motor Does Not Put Out Torque of If Acceleration is Slow

■ The torque limit has been reached.

- When a torque limit has been set in constants L7-01 to L7-04, no torque will be output beyond that limit. This can cause the torque to be insufficient, or the acceleration time to be too long. Check to be sure that the value set for the torque limit is suitable.

  If the torque limit has been set by multi-function analog inputs H3-05 and H3-09 (set value: 10 to 13), check to be sure that the analog input value is suitable.

■ The Stall Prevention level during acceleration is too low.

- If the value set for L3-06 (Stall Prevention level during running) is too low, the speed will drop before outputting torque. Check to be sure that the set value is suitable.

9.2.5 If the Motor Does Not Operate According to Reference

■ The motor runs faster than reference.

1. The frequency reference bias setting is wrong (the gain setting is wrong).
   - The frequency reference bias set in constant H3-03 is added to the frequency reference. Check to be sure that the set value is suitable.
2. Frequency bias is set for multi-function analog inputs.
   - When "2" (frequency bias) is set for multi-function analog inputs H3-05 and H3-09, a frequency corresponding to the input voltage (current) is added to the frequency reference. Check to be sure that the set value and analog input value are suitable.
3. A signal is being input to the frequency reference (current) Terminal 14.
   - When ''1F" (frequency reference) is set for constant H3-09 (multi-function analog input Terminal 14), a frequency corresponding to the Terminal 14 input voltage (current) is added to the frequency reference. Check to be sure that the set value and analog input value are suitable.

■ The motor does not rotate according to reference.

- Torque Control mode is selected. When constant d5-01 (Torque Control selection) is set to "1" (Torque Control), Speed Control cannot be executed. (Speed limits can be set.)
- To switch Torque Control and Speed Control, set the following:
  - Set constant d5-01 to "0" (Speed Control).
  - Set one of the constants from H1-01 through H1-06 (multi-function inputs) to "71" (Speed/Torque Control Change).

9.2.6 If the Slip Compensation Function Has Low Speed Precision

- The slip compensation limit has been reached. With the slip compensation function, compensation cannot be carried out beyond the slip compensation limit set in constant C3-03. Check to be sure that the set value is suitable.

9.2.7 If There is Low Speed Control Accuracy at High-Speed Rotation in Open-Loop Vector Control Mode

- The motor's rated voltage is high.
- The Inverter's maximum output voltage is determined by its input voltage. (For example, if 200 VAC is input, then the maximum output voltage will be 200 VAC.) If, as a result of Vector Control, the output voltage reference value exceeds the Inverter output voltage maximum value, the Speed Control accuracy will decrease. Either use a motor with a low rated voltage (i.e., a special motor for use with vector control) or change to Flux Vector Control.

9.2.8 If Motor Deceleration is Slow

■ The deceleration time is long even when control resistance is connected.

1. "Stall Prevention during deceleration enabled" is set.
   - When control resistance is connected, set constant L3-04 (Stall Prevention selection during deceleration) to "0" (disabled). When this constant is set to "1" (enabled, the factory-set default), control resistance is not used.
2. **The deceleration time setting is too long.**
   - Check the deceleration time setting (constants C1-02, C1-04, C1-06, and C1-08).
3. **Motor torque is insufficient.**
   - If the constants are correct and there is no overvoltage fault, then the motor's power is limited. Consider increasing the motor capacity.
4. **The torque limit has been reached.**
   - When a torque limit has been set in constants L7-01 to L7-04, no torque will be output beyond that limit. This can cause the deceleration time to be too long. Check to be sure that the value set for the torque limit is suitable.
   - If the torque limit has been set by multi-function analog inputs H3-05 and H3-09 (set value: 10 to 13), check to be sure that the analog input value is suitable.

■ If the Vertical-Axis Load Drops When Brake is Applied

- The sequence is incorrect.
- The Inverter goes into DC Injection Braking status for 0.5 seconds after deceleration is completed. (This is the factory-set default.)
- To ensure that the brake holds, set frequency detection 2 (H2-01 = 5) for the multi-function contact output Terminals (9-10) so that the contacts will open when the output frequency is greater than L4-01 (3.0 to 5.0 Hz). (The contacts will close below L4-01.)
- There is hysteresis in frequency detection 2 (L4-02 = 2.0 Hz). Change the setting to approximately 0.5 Hz if there are drops during stop. Do not use the "running" signal (H2-01 = 0) for the brake ON/OFF signal.

9.2.9 If the Motor Overheats

■ The load is too big.

- If the motor load is too heavy and the motor is used with the effective torque exceeding the motor's rated torque, the motor will overheat. Some motor ratings are given for short period performance and are not continuous ratings. Reduce the load amount by either lightening the load or lengthening the acceleration/deceleration time. Also consider increasing the motor capacity.

■ The ambient temperature is too high.

- The motor rating is determined within a particular ambient operating temperature range. The motor will burn out if it is run continuously at the rated torque in an environment in which the maximum ambient operating temperature is exceeded. Lower the motor's ambient temperature to within the acceptable ambient operating temperature range.

■ The withstand voltage between the motor phases is insufficient.

- When the motor is connected to the Inverter output, a surge is generated between the Inverter switching and the motor coil. Normally the maximum surge voltage is three times the Inverter's input power supply voltage (i.e., 1,200 V for 400 V class). Be sure to use a motor with a withstand voltage between the motor phases that is greater than the maximum surge voltage. In particular, when using a 400 V class Inverter, use a special motor for Inverters.

9.2.10 If There is Noise When the Inverter is Started or On an AM Radio

- If noise is generated by Inverter switching, implement the following countermeasures:
  - Lower the Inverter's carrier frequency (constant C6-01). This will help to some extent by reducing the amount of internal switching.
  - Install an Input Noise Filter at the Inverter's power supply input area.
  - Install an Output Noise Filter at the Inverter's power supply output area.
  - Use metal tubing. Electric waves can be shielded by metal, so encase the Inverter with metal (steel).
  - Ground the Inverter and motor.
  - Separate main circuit wiring from control wiring.

9.2.11 If the Ground Fault Interrupter Operates When the Inverter is Run

- The Inverter performs internal switching, so there is a certain amount of leakage current. This may cause the ground fault interrupter to operate and cut off the power supply. Change to a ground fault interrupter with a high leakage detection level (i.e., a sensitivity current of 200 mA or greater per Unit, with an operating time of 0.1seconds or more), or one that incorporates high frequency countermeasures (i.e., one designed for use with Inverters). It will also help to some extent to lower the Inverter's carrier frequency (constant C6-01).

  In addition, remember that the leakage current increases as the cable is lengthened.

9.2.12 If There is Mechanical Oscillation

■ The machinery is making unusual sounds.

1. There may be resonance between the mechanical system's characteristic frequency and the carrier frequency.
   - If the motor is running with no problems and the machinery is oscillating with a high-pitched whine, it may indicate that this is occurring. To prevent this type of resonance, adjust the carrier frequency with constants C6-01 to C6-03.
2. There may be resonance between a machine's characteristic frequency and the output frequency of the Inverter.
   - To prevent this from occurring, either use the jump frequency functions in constants d3-01 to d3-04 or install rubber padding on the motor base to reduce oscillation.

■ Oscillation and hunting are occurring with Open-Loop Vector Control.

- The gain adjustment may be insufficient. Reset the gain to a more effective level by adjusting constants C4-02 (torque compensation time constant), C8-08 (AFR gain), and C3-02 (slip compensation primary delay time) in order. Lower the gain setting and raise the primary delay time setting.

■ Oscillation and hunting are occurring with V/f Control.

- The gain adjustment may be insufficient. Reset the gain to a more effective level by adjusting constants C4-02 (torque compensation time constant), C7-02 (Hunting Prevention gain), and C3-02 (slip compensation primary delay time) in order. Lower the gain setting and raise the primary delay time setting.

■ Oscillation and hunting are occurring with Flux Vector Control.

- The gain adjustment may be insufficient. Adjust the various types of ASR gain. (For details, refer to Page 130.)
- If the mechanical system's resonance point coincides with the Inverter's operating frequency and the oscillation cannot be eliminated in this way, increase the ASR primary delay time (constant C5-06) and then try adjusting the gain again.

■ Oscillation and hunting are occurring with V/f with PG Control.

- The gain adjustment may be insufficient. Adjust the various types of ASR gain. (For details, refer to Page 137.)
- If the oscillation cannot be eliminated in this way, set the Hunting Prevention selection (constant C7-01) to "0" (disabled) and then try adjusting the gain again.

■ Oscillation and hunting are occurring with PID Control.

- Check the oscillation cycle and individually adjust the P, I, and D. (Refer to Page 177.)

9.2.13 If the Motor Rotates Even When Inverter Output is Stopped

- The DC Injection Braking is insufficient. If the motor continues operating at low speed, without completely stopping, and after a deceleration stop has been executed, it means that the DC Injection Braking is not decelerating enough. Adjust the DC Injection Braking as follows:
  - Increase the constant b2-02 (DC Injection Braking current) setting.
  - Increase the constant b2-04 (DC Injection Braking time at stop) setting.

9.2.14 If 0 V is Detected When the Fan is Started, or Fan Stalls

- Generation of 0 V and stalling can occur if the fan is turning when it is started. The DC Injection Braking is insufficient when starting.
- This can be prevented by slowing fan rotation by DC Injection Braking before starting the fan. Increase the constant b2-03 (DC Injection Braking time at start) setting.

9.2.15 If Output Frequency Does not Rise to Frequency Reference

■ The frequency reference is within the jump frequency range.

- When the jump frequency function is used, the output frequency does not change within the jump frequency range.
- Check to be sure that the jump frequency (constants d3-01 to d3-03) and jump frequency width (constant d3-04) settings are suitable.

■ The frequency reference upper limit has been reached.

- The output frequency limit is determined by the following formula:
  Maximum output frequency (E1-04) **x** Frequency reference upper limit (d2-01) / 100
- Check to be sure that the constant E1-04 and d2-01 settings are suitable.

10

Maintenance and Inspection

This chapter describes basic maintenance and inspection for the VG5.

WARNING

- Do not touch the Inverter terminals. Some of the terminals carry high voltages and are extremely dangerous. Doing so can result in electric shock.
- Always have the protective cover in place when power is being supplied to the Inverter. When attaching the cover, always turn OFF power to the Inverter through the MCCB. Doing so can result in electric shock.
- After turning OFF the main circuit power supply, wait until the CHARGE indicator light goes out before performance maintenance or inspections. The capacitor will remain charged and is dangerous.

Maintenance, inspection, and replacement of parts must be performed only by authorized personnel. Remove all metal objects, such as watches and rings, before starting work. Always use grounded tools. Failure to heed these warnings can result in electric shock.

CAUTION

- A CMOS IC is used in the control board. Handle the control board and CMOS IC carefully. The CMOS IC can be destroyed by static electricity if touched directly.
- Do not change the wiring, or remove connectors or the Digital Operator, during operation. Doing so can result in personal injury.

10.1 Maintenance and Inspection

The maintenance period of the Inverter is as follows:

Maintenance Period: Within 18 months of shipping from the factory or within 12 months of being delivered to the final user, whichever comes first.

10.1.1 Daily Inspection

Check the following items with the system in operation.

- The motor should not be vibrating or making unusual noises.
- There should be no abnormal heat generation.
- The ambient temperature should not be too high.
- The output current value shown on the monitor display should not be higher than normal.
- The cooling fan on the bottom of the Inverter should be operating normally.

10.1.2 Periodic Inspection

Check the following items during periodic maintenance.

Always turn OFF the power supply before beginning inspection. Confirm that the LED indicators on the front cover have all turned OFF, and then wait until at least one minute (or at least three minutes for Inverters of 30 kW or more) has elapsed before beginning the inspection. Be sure not to touch terminals right after the power has been turned off. Doing so can result in electric shock.

Table 10.1 Periodic Inspections

Item	Inspection	Corrective Procedure
External terminals, mounting bolts, connectors, etc.	Are all screws and bolts tight?	Tighten loose screws and bolts firmly.
	Are connectors tight?	Reconnect the loose connectors.
Cooling fins	Are the fins dirty or dusty?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2 X 10^4 to 58.8 X 10^4 Pa).
PCBs	Is there any conductive dirt or oil mist on the PCBs?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2 X 10^4 to 58.8 X 10^4 Pa. Replace the boards if they cannot be made clean.
Cooling fan	Is there any abnormal noise or vibration or has the total operating time exceeded 20,000 hours?	Replace the cooling fan.
Power elements	Is there any conductive dirt or oil mist on the elements?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2 X 10^4 to 58.8 X 10^4 Pa).
Smoothing capacitor	Are there any irregularities, such as discoloration or odor?	Replace the capacitor of Inverter.

10.1.3 Periodic Maintenance of Parts

The Inverter is configured of many parts, and these parts must be operating properly in order to make full use of the Inverter functions.

Among the electronic components, there are some that require maintenance depending on their usage conditions. In order to keep the Inverter operating normally over a long period of time, it is necessary to perform period inspections and replace parts according to their service life.

Periodic inspection standards vary depending the Inverter's installation environment and usage conditions. The Inverter's maintenance periods are noted below. Keep them as reference.

Table 10.2 Part Replacement Guidelines

Part	Standard Replacement Period	Replacement Method
Cooling fan	2 to 3 years	Replace with new part.
Smoothing capacitor	5 years	Replace with new part. (Determine need by inspection.)
Breaker relays	—	Determine need by inspection.
Fuses	10 years	Replace with new part.
Aluminum capacitors on PCBs	5 years	Replace with new board. (Determine need by inspection.)

NOTE: Usage conditions are as follows:
- Ambient temperature: Yearly average of 30°C
- Load factor: 80% maximum.
- Operating rate: 12 hours maximum per day.

11

Specifications

This chapter describes the basic specifications of the VG5 and specifications for options and peripheral devices.

11.1 Standard Inverter Specifications

Table 11.1 200 V Class Inverters

Model Number VG5		20P4	20P7	21P5	22P2	23P7	25P5	27P5	2011	2015	2018	2022	2030	2037	2045	2055	2075
Maximum applicable motor output (kW)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75
Output ratings	Rated output capacity (kVA)	1.2	2.3	3.0	4.2	6.7	9.5	13	19	24	30	37	50	61	70	85	110
	Nominal Motor Output (HP)*	0.75	1.5	2	3	5	7.5	10	15	20	25	30	40	50	60	75	100
	Rated output current (A)	3.2	6	8	11	17.5	25	33	49	64	80	96	130	160	183	224	300
	Maximum output voltage (V)	3-phase, 200 to 230 VAC (Proportional to input voltage.)															
	Rated output frequency (Hz)	Up to 400 Hz (available by programming)															
Power supply characteristics	Voltage (V) Frequency (Hz)	3-phase, 200 to 230 VAC, 50/60 Hz															
	Allowable voltage fluctuation	+ 10%, – 15%															
	Allowable frequency fluctuation	± 5%															
Control characteristics	Control method	Sine wave PWM															
	Torque characteris-tics	150% at 1 Hz (150% at 0 r/min with PG).[2]															
	Speed Control range	1: 100 (1:1000 with PG)*[2]															
	Speed Control accuracy	± 0.2% (± 0.02% with PG)*[2]															
	Speed Control response	5 Hz (30 Hz with PG)*[2]															
	Torque limits	Provided (4 quadrant steps can be changed by constant settings.)															
	Torque accuracy	± 5%															
	Frequency control range	0.1 to 400 Hz															
	Frequency accuracy (temperature characteris-tics)	Digital references: ± 0.01% (– 10°C to 40°C)															
		Analog references: ± 0.1% (25°C ± 10°C)															
	Frequency setting resolution	Digital references: 0.01 Hz															
		Analog references: 0.03 Hz / 60 Hz (11 bits + sign)															
	Output frequency resolution	0.001 Hz															
	Overload capacity	150% of rated current for one minute															
	Frequency setting signal	– 10 to 10V, 0 to 10 V, 4 to 20 mA															
	Acceleration/ Deceleration time	0.01 to 6000.0 seconds (4 selectable combinations of independent acceleration and deceleration settings)															
	Braking torque	Approximately 20%															

* HP Ratings based on NEMA 4-pole motor data. However, when sizing a drive to match a motor, use output current ratings.

Model Number VG5		20P4	20P7	21P5	22P2	23P7	25P5	27P5	2011	2015	2018	2022	2030	2037	2045	2055	2075
Protective functions	Motor protection	Protection by electronic Thermal Overload Relay.															
	Instant-aneous overcurrent protection	Stops at approximately 200% of rated output current.															
	Fuse blown protection	Stops for fuse blown.															
	Overload protection	Stops in one minute at approx. 150% of rated output current.															
	Overvoltage protection	Stops when main-circuit DC voltage is approx. 410 V															
	Undervoltage protection	Stops when main-circuit DC voltage is approx. 190 V															
	Momentary power loss ridethru	Stops for 15 ms or more. By selecting the momentary power loss mode, operation can be continued if power is restored within 2 seconds.															
	Cooling fin overheating	Protection by thermistor.															
	Stall Prevention	Stall Prevention during acceleration, deceleration, or running.															
	Grounding protection	Protection by electronic circuits. (Overcurrent level)															
	Charge indicator (internal LED)	Lit when the main circuit DC voltage is approximately 50 V or more.															
Environment	Ambient operating temperature	– 10° to 40°C (Enclosed wall-mounted type) 10° to 45°C (Open chassis type)															
	Ambient operating humidity	90% RH maximum															
	Storage temperature	– 20°C to + 60°C															
	Application site	Indoor (no corrosive gas, dust, etc.)															
	Altitude	3,281 feet maximum															
	Vibration	10 to 20 Hz, 9.8 m/s^2 (1G) maximum; 20 to 50 Hz, 2 m/s^2 (0.2G) max															

[1] The maximum applicable motor output is given for a standard 4-pole Saftronics motor. When selecting the actual motor and Inverter, be sure that the Inverter's rated current is applicable for the motor's rated current.

[2] Tuning is sometimes required.

Table 11.2 400 V Class Inverters

	Model Number VG5	40P4	40P7	41P5	42P2	43P7	44P0	45P5	47P5	4011	4015	4018	4022	4030	4037	4045	4055	4075	4110	4160	4185	4220	4300
	Maximum applicable motor output (kW)	0.4	0.75	1.5	2.2	3.7	4	5.5	7.5	11	15	18.5	22	30	37	45	55	75	110	160	185	220	300
Output ratings	Nominal Motor Output (HP)*	1	2	3	4	5	7.5	10	15	20	25	30	40	50	60	75	100	125	150	200	250	350	500
	Rated output capacity (kVA)	1.4	2.6	3.7	4.7	6.1	8.4	11	14	21	26	31	37	50	61	73	98	130	170	230	260	340	460
	Rated output current (A)	1.9	3.6	5.1	6.6	8.5	11.7	14.8	21	28.6	34	41	52	65	80	96	128	165	224	302	340	450	605
	Maximum output voltage (V)	3-phase, 380 to 460 VAC (Proportional to input voltage.)																					
	Rated output frequency (Hz)	Up to 400 Hz (available by programming.)																					
Power supply characteristics	Voltage (V) Frequency (Hz)	3-phase, 380 to 460 VAC, 50/60 Hz																					
	Allowable voltage fluctuation	+ 10%, – 15%																					
	Allowable frequency fluctuation	± 5%																					
Control characteristics	Control method	Sine wave PWM																					
	Torque characteristics	150% at 1 Hz (150% at 0 r/min with PG).																					
	Speed Control range	1: 100 (1: 1000 with PG)*2																					
	Speed Control accuracy	± 0.2% (± 0.02% with PG)*2																					
	Speed Control response	5 Hz (30 Hz with PG)*2																					
	Torque limits	Provided (4 quadrant steps can be changed by constant settings.)																					
	Torque accuracy	± 5%																					
	Frequency control range	0.1 to 400 Hz																					
	Frequency accuracy (temperature characteristics)	Digital references: ± 0.01% (– 10°C to 40°C)																					
		Analog references: ± 0.1% (25°C ± 10°C)																					
	Frequency setting resolution	Digital references: 0.01 Hz																					
		Analog references: 0.03 Hz/60 Hz (11 bits + sign)																					
	Output frequency resolution	0.001 Hz																					
	Overload capacity	150% of rated current for one minute																					
	Frequency setting signal	– 10 to 10 V, 0 to 10 V, 4 to 20 mA																					
	Acceleration/ Deceleration time	0.01 to 6000.0 seconds (4 selectable combinations of independent acceleration and deceleration settings)																					
	Braking torque	Approximately 20%																					

* HP Ratings based on NEMA 4-pole motor data. However, when sizing a drive to match a motor, use output current ratings.

Model Number VG5		40P4	40P7	41P5	42P2	43P7	44P0	45P5	47P5	4011	4015	4018	4022	4030	4037	4045	4055	4075	4110	4160	4185	4220	4300
Protective functions	Motor protection	Protection by electronic Thermal Overload Relay.																					
	Instant-aneous overcurrent protection	Stops at approximately 200% of rated output current.																					
	Fuse blown protection	Stops for fuse blown.																					
	Overload protection	Stops in one minute at approx. 150% of rated output current.																					
	Overvoltage protection	Stops when main-circuit DC voltage is approx. 820V																					
	Undervoltage protection	Stops when main-circuit DC voltage is approx. 380V																					
	Momentary power loss ridethru	Stops for 15 ms or more. By selecting the momentary power loss mode, operation can be continued if power is restored within 2 seconds.																					
	Cooling fin overheating	Protection by thermistor.																					
	Stall Prevention	Stall Prevention during acceleration, deceleration, or running.																					
	Grounding protection	Protection by electronic circuits. (Overcurrent level)																					
	Charge indicator (internal LED)	Lit when the main circuit DC voltage is approximately 50 V or more.																					
Environment	Ambient operating temperature	– 10° to 40°C (Enclosed wall-mounted type) – 10° to 45°C (Open chassis type)																					
	Ambient operating humidity	90% RH maximum																					
	Storage temperature	– 20°C to + 60°C																					
	Application site	Indoor (no corrosive gas, dust, etc.)																					
	Altitude	3,281 feet maximum																					
	Vibration	10 to 20 Hz, 9.8 m/s^2 {1G} maximum; 20 to 50 Hz, 2 m/s^2 { 0.2G} max																					

1 The maximum applicable motor output is given for a standard 4-pole Saftronics motor. When selecting the actual motor and Inverter, be sure that the Inverter's rated current is applicable for the motor's rated current.

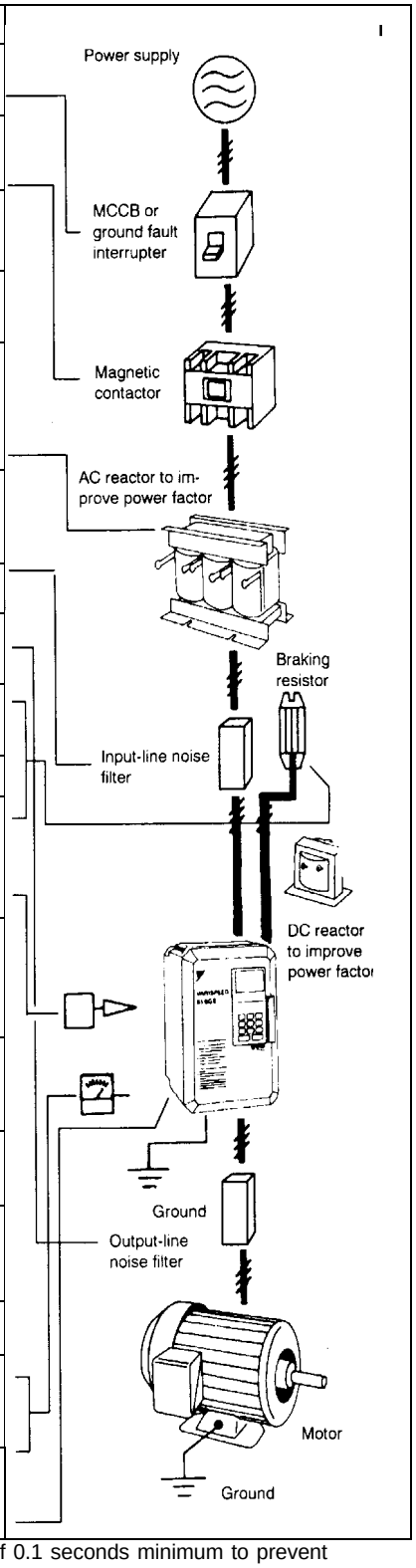
2 Tuning is sometimes required.

11.2 Specifications of Options and Peripheral Devices

The following options and peripheral devices can be used for the VG5. Select them according to the application.

Table 11.3 Options and Peripheral Devices

Purpose	Name	Model	Descriptions
Protect Inverter wiring	MCCB or Ground Fault Interrupter	See Product Guide	Always connect a breaker to the power supply line to protect Inverter wiring. Use a ground fault interrupter suitable for high frequencies.
Prevents burning when a Braking Resistor is used.	Magnetic Contactor	See Product Guide	Install to prevent the braking resistor from burning out when one is used. Always attach a surge absorber to the coil
Contains switching surge	Surge Absorber	C500016	Absorbs surge from the Magnetic Contactor and control relays. Connect surge absorbers to all Magnetic Contactors and relays near the Inverter.
Isolates I/O signals	Isolator	See Product Guide	Isolates the I/O signals of the Inverter and is effective against inductive noise.
Improve the input power factor of the Inverter	DC Reactor AC Reactor	See Product Guide	Used to improve the input power factor of the Inverter. All VG5 Inverters of 18.5 kW or higher contain built-in DC Reactors. These are optional for Inverters of 15 kW or less. Install DC and AC Reactors for applications with a large power supply capacity (600 kVA or higher).
Reduce the affects of radio and control device noise	Input Noise Filter	Single-phase: See Product Guide 3-phase: See Product Guide	Reduces noise coming into the Inverter from the power supply line and to reduce noise flowing from the Inverter into the power supply line. Connect as close to the Inverter as possible.
	Output Noise Filter	See Product Guide	Reduces noise generated by the Inverter. Connect as close to the Inverter as possible.
Enable stopping the machine in a set time	Braking Resistor	See Product Guide	Consumes the regenerative motor energy with a resistor to reduce deceleration time (use rate: 3% ED).
	Braking Resistor Unit	See Product Guide	Consumes the regenerative motor energy with a resistor to reduce deceleration time (use rate: 10% ED).
	Braking Unit	See Product Guide	Used with a Braking Resistor Unit to reduce the deceleration time of the motor.
Operates the Inverter externally	VS Operator *2 (small plastic Operator	E001062-29	Allows frequency reference settings and ON/OFF operation control to be performed by analog references from a remote location (50 meters max.). Frequency counter specifications: 6-/120 Hz
	VS Operator (Standard steel-plate Operator)	E001062-19	Allows frequency reference settings and ON/OFF operation control to be performed by analog references from a remote location (50 meters max.). Frequency counter specifications: 75 Hz
	Digital Operator Connection Table	1 meters cable: (018-9001-36) 3 meters cable: (018-9001-120)	Extension cable to use a Digital Operator remotely. Cable length: 1 meters or 3 m
Provides Inverter momentary power loss recovery time	Momentary Power Loss Recovery Unit	See Product Guide	Handles momentary power losses for the control power supply (maintains power for 2 s).
Set/monitor frequencies and voltages externally	Frequency Meter	See Product Guide	Devices to set or monitor frequencies externally.
	Frequency Meter	See Product Guide	
	Frequency Setter Knob	See Product Guide	
	Output Voltmeter	See Product Guide	Measures the output voltage externally and designed for use with a PWM Inverter.
Correct frequency reference input, frequency meter, ammeter scales	Variable Resistor Board for Frequency Reference	2 k Ω: (A210060) 20 k: (AA1143-2B)	Connected to the control circuit terminals to input a frequency reference.
	Frequency Meter Scale Correction Resistor	See Product Guide	Calibrates the scale of frequency meters and ammeters.



[1] Use a ground fault interrupter with a current sensitivity of 200 mA minimum and an operating time of 0.1 seconds minimum to prevent operating errors. The interrupter must be suitable for high-frequency operation.

[2] The suffixes of the model and code number of VS Operators indicate frequency meters are shown in the following table.

Model No.	Part Number	Frequency Meter Specifications
JVOP-95-1	E001062-29	TRM-45 3 V 1 mA 60/120 Hz
JVOP-95-2	E001062-30	TRM-45 3 V 1 mA 60/180 Hz
JVOP-96 -1	E001062-19	DCF-6A 3 V 1 mA 75 Hz
JVOP-96-2	E001062-31	DCF-6A 3 V 1 mA 150 Hz
JVOP-96-3	E001062-32	DCF-6A 3 V 1 mA 220 Hz

The following Option Cards are available

Table 11.4 Option Cards

Type		Name	Part Number	Descriptions
Built-in (connect to connector)	Speed (frequency) reference Optional Cards	Analog Reference Card AI-14U	E001067-08	Used to set high-accuracy, high-resolution analog speed references. • Input signal levels: 0 to +10 VDC (20 K Ω) 1 channel 4 to 20 mA DC (250 Ω) 1 channel • Input resolution: 4 bits (1/16384)
		Analog Reference Card AI-14B	E001067-09	Used to set high-accuracy, high-resolution analog speed references. • Input signal levels: 0 to ±10 VDC (20 K Ω) 4 to 20 mA DC (500 Ω) 3 channels • Input resolution: 13 bits (1/8192)
		Digital Reference Card DI-08	E001067-10	Used to set frequency references in 2-digit BCD or 8-bit binary. • Input signal: 8 bits binary 2 digits BCD + SIGN signal + SET signal • Input voltage: + 24 V (insulated) • Input current: 8 mA
		Digital Reference Card DI-16H2	031-4010	Used to set 16-bit digital speed references. • Input signal: 16 bits binary 4 digits BCD + SIGN signal + SET signal • Input voltage: + 24 V (insulated) • Input current: 8 mA Used to set frequency references with 16 or 12 bits (switchable).
	RS-232C/485/422 Interface Card SI-K2		100-0043-01	Used to convert RS-232C to RS-485 or RS-422. Supports baud rates up to 9.6 kbps.
	Monitoring Optional Cards	Analog Monitor Card AO-08	E001067-11	Converts analog signals to monitor the Inverter's output status (output frequency, output current, etc.) to absolute values and outputs them. • Output resolution: 8 bits (1/256) • Output voltage: 0 to + 10 V (not insulated) • Output channels: 2 channels
		Analog Monitor Card AO-12	E001067-12	Output analog signals to monitor the Inverter's output status (output frequency, output current, etc.). • Output resolution: 11 bits (1/2048) + sign • Output voltage: – 10 to + 10 V (not insulated) • Output channels: 2 channels
		Pulse Monitor Card PO-36F	E001067-13	Used to output pulse-train signals according to the output frequency of the Inverter. • Output pulse: 1F, 6F, 10F, 12F, 36F (F: Output frequency) • Output voltage: + 12 V ± 10% (insulated)
		Digital Output Card DO-08	E001067-13	Outputs isolated digital signals to monitor the Inverters operating status (alarm signals, Zero Speed detection, etc.) • Output form: Photocoupler output, 6 channels (48 V, 50 mA max.) Relay contact outputs, 2 channels (250 VAC: 1A max., DC 30V: 1 A max.)
		2C-Relay Output Card DO-02C	031-4011	Provides two multi-function outputs (DPDT relay contacts) in addition to those provided by the Inverter.

Table 11.4 Option Cards (Continued)

Type		Name	Part Number	Descriptions
Built-in (connect to connector)	PG Speed Control Cards	PG-A2	031-4005	Used for V/ f Control. Speed feedback is performed using the PG attached to the motor to compensate for speed fluctuations caused by slipping. • A-Phase pulse (single pulse) input (voltage, complementary, open-collector input • Maximum input frequency: 32767 Hz • Pulse monitor output: + 12 V, 20 mA (PG power supply output: + 12 V, 200 mA max.)
		PG-B2	031-4006	• Used for Flux Vector Control • A-, B-Phase input (complimentary input) • Maximum input frequency: 3276 Hz • Pulse monitor output: Open-collector (PG power supply output: + 12 V, 200 mA max.)
		PG-D2	031-4007	• Differential input. • A-Phase pulse (differential pulse) input, for V/f Control • Maximum input frequency: 300 kHz • Input: Conforms to RS-422 • Pulse monitor output: RS-422 (PG power supply output: + 5 or + 12 V, 200 mA max.)
		PG-X2	E001063-28	Used for Flux Vector Control. • A-, B-, Z-Phase pulse (differential pulse) input • Maximum input frequency: 300 kHz • Input: Conforms to RS-4 • Pulse monitor output: RS-422 (PG power supply output: + 5 or + 12 V, 200 mA max.)

12

Appendix

This chapter provides precautions for the Inverter, motor, and peripheral devices and also provides lists of constants.

12.1 Inverter Application Precautions

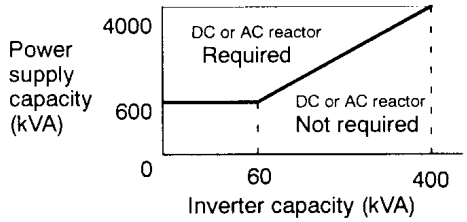
12.1.1 Selection

■ Installing Reactors

A large peak current will flow in the power input circuit when the Inverter is connected to a large-capacity power transformer (600 k VA or higher) or when switching a phase capacitor. Excessive peak current can destroy the converter section. To prevent this, install a DC or AC Reactor (optional) to improve the power supply power factor.

DC Reactors are built into 200 V class Inverters of 18.5 to 75 kW and 400 V class Inverters of 18.5 to 160 kW.

If a thyrister converter, such as a DC drive, is connected in the same power supply system, connect a DC or AC Reactor regardless of the power supply conditions shown in the following diagram.



■ Inverter Capacity

When connecting special motors or multiple motors in parallel to an Inverter, select the Inverter capacity so that the rated output current of the Inverter is 1.1 times the sum of all the motor rated currents.

■ Initial Torque

The startup and acceleration characteristics of the motor are restricted by the overload current ratings of the Inverter that is driving the motor. The torque characteristics are generally less than those required when starting using a normal commercial power supply. If a large initial torque is required, select an Inverter with a somewhat larger capacity or increase the capacity of both the motor and the inverter.

■ Emergency Stop

Although the Inverter's protective functions will stop operation when a fault occurs, the motor will not stop immediately. Always provide a mechanical stop and protection mechanisms on equipment requiring an emergency stop. The Inverter does not provide a fail safe emergency stop.

■ Options

Terminals B1, B2, √, ⊕ 1, ⊕ 2, ⊕ 3 are for connecting only the options specifically provided by Saftronics. Never connect any other devices to these terminals.

12.1.2 Installation

■ Installation in Enclosures

Either install the Inverter in a clean location not subject to oil mist, air-borne matter, dust, and other contaminants, or install the Inverter in a completely enclosed panel. Provide cooling measures and sufficient panel space so that the temperature surrounding the Inverter does not go beyond the allowable temperature. Do not install the Inverter on wood or other combustible materials.

■ Installation Direction

Mount the Inverter vertically to a wall or other horizontal surface.

12.1.3 Settings

■ Upper Limits

The Digital Operator can be used to set high-speed operation up to a maximum of 400 Hz. Incorrect settings can be dangerous. Use the maximum frequency setting functions to set upper limits. (The maximum output frequency is factory-set to 60 Hz.)

■ DC Injection Braking

The motor can overheat if the DC Injection Braking voltage or braking time is set to a large value.

■ Acceleration/Deceleration Times

The motor's acceleration and deceleration times are determined by the torque generated by the motor, the load torque, and the load's inertial moment ($GD^2/4$). If the Stall Prevention functions are activated during acceleration or deceleration, increase the acceleration or deceleration time. The Stall Prevention functions will increase the acceleration or deceleration time by the amount of time the Stall Prevention function is active.

To reduce the acceleration or deceleration times, increase the capacity of the motor and Inverter.

12.1.4 Handling

■ Wiring Check

The Inverter will be internally damaged if the power supply voltage is applied to output Terminal T1, T2, and T3 (U, V, or W). Check wiring for any mistakes before supplying power. Check all wiring and sequences carefully.

■ Magnetic Contactor Installation

Do not start and stop operation frequently with a Magnetic Contactor installed on the power supply line. Doing so can cause the Inverter to malfunction.

■ Inspections

The Internal capacitors in the Inverter require time to discharge after the power supply is turned OFF. Do not start inspections until the CHARGE indicator goes out.

■ Wiring UL/C-UL Inverters

Always use Closed-Loop connectors when wiring Inverters that meet UL or C-UL standards. Always use the crimp tool specified by the manufacturer of the Closed-Loop connectors.

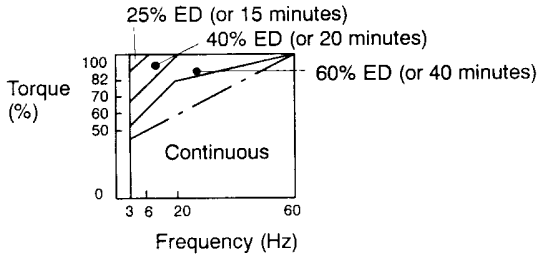
12.2 Motor Application Precautions

12.2.1 Using the Inverter for an Existing Standard Motor

When a standard motor is operated with the Inverter, power loss is slightly higher than when operated with a commercial power supply. In addition, cooling effects also diminish in the low-speed range, resulting in an increase in the motor temperature. Therefore, the motor torque should be reduced in the low-speed range.

The following graph shows the allowable load characteristics of a standard motor.

If 100% torque is continuously required in the low-speed range, use a special motor for use with inverters.



If the input voltage is high (440 V or higher) or the wiring distance is long, the motor insulation voltage must be considered. Contact your Saftronics representative for details.

■ High-Speed Operation

When using the motor at a high speed (60 Hz or more), problems may arise in dynamic balance and bearing durability. Contact your Saftronics representative for details.

■ Torque Characteristics

The motor may require more acceleration torque when the motor is operated with the Inverter than when operated with a commercial power supply. Check the load torque characteristics of the machine to be used with the motor to set a proper V/f pattern.

Vibration

The Inverter uses a high carrier PWM to reduce motor vibration. When the motor is operated with the Inverter, motor vibration is almost the same as when operated with a commercial power supply.

Motor vibration may, however, become greater in the following cases.

Resonance with the Natural Frequency of the Mechanical System

Take special care when a machine that has been operated at a constant speed is to be operated in variable speed mode.

If resonance occurs, install vibration-proof rubber on the motor base or use the frequency jump function to skip any frequency resonating the machine.

Imbalanced Rotor

Take special care when the motor is operated at a higher speed (60 Hz or more).

Noise

Noise is almost the same as when the motor is operated with a commercial power supply. Motor noise, however, becomes louder when the motor is operated at a speed higher than the rated speed (60 Hz).

12.2.2 Using the Inverter for Special Motors

Pole-Changing Motor

The rated input current of pole-changing motors differs from that of standard motors. Select, therefore, an appropriate Inverter according to the maximum input current of the motor to be used.

Before changing the number of poles, always make sure that the motor has stopped. Otherwise, the overvoltage protective or overcurrent protective mechanism will be actuated, resulting in an error.

Submersible Motor

The rated input current of submersible motors is higher than that of standard motors. Therefore, always select an Inverter by checking its rated output current.

When the distance between the motor and Inverter is long, use a cable thick enough to connect the motor and Inverter to prevent motor torque reduction.

Explosion-proof Motor

When an explosion-proof motor or increased safety-type motor is to be used, it must be subject to an explosion-proof test in conjunction with the Inverter. This is also applicable when an existing explosion-proof motor is to be operated with the Inverter.

Since the Inverter itself is, however, not explosion-proof, always install it in a safe place.

Gearmotor

The speed range for continuous operation differs according to the lubrication method and motor manufacturer. In particular, continuous operation of an oil-lubricated motor in the low speed range may result in burning. If the motor is to be operated at a speed higher than 60 Hz, consult with the manufacturer.

Synchronous Motor

A synchronous motor is not suitable for Inverter control.

If a group of synchronous motors is individually turned ON and OFF, synchronism may be lost.

Single-Phase Motor

Do not use an Inverter for a single-phase motor. The motor should be replaced with a 3-phase motor.

12.2.3 Power Transmission Mechanism (Speed Reducers, Belts, and Chains)

If an oil-lubricated gearbox or speed reducer is used in the power transmission mechanism, oil lubrication will be affected when the motor operates only in the low speed range. The power transmission mechanism will make noise and experience problems with service life and durability if the motor is operated at a speed higher than 60 Hz.

12.3 Peripheral Device Application Precautions

Selecting and Installing Wiring Breakers

Install an MCCB on the power supply line to the Inverter to protect the wiring. Select the MCCB according to the Inverter's power supply power factor (which changes with the supply voltage, output frequency, and load). Contact your Saftronics representative for selection standards. Operating characteristics of completely magnetic MCCB's change with high-frequency currents. Select a model with a large capacity. We recommend using only ground fault interrupters designed for Inverters.

Using Magnetic Contactors on the Power Supply Line

The Inverter can be used without a Magnetic Contactor on the power supply line. Although Magnetic Contactor can be installed to protect from accidents that can occur by automatic recovery following power losses during remote operation, do not start and stop operation frequently with a Magnetic Contactor installed on the power supply line. Doing so can cause the Inverter to malfunction. The motor will not be automatically restarted after power recovery during Digital Operator operation, and starting via a Magnetic Contactor is thus not possible.

Although operation can be stopped using a Magnetic Contactor in the power supply line, the regenerative control of the Inverter will not operate and a coast to a stop will occur. If a Braking Unit or Braking Resistor Unit is used, wire a sequence that turns OFF the Magnetic Contactor with the thermal protector contact of the Braking Resistor Unit.

Using Magnetic Contactors on the Motor Line

As a rule, do not install a Magnetic Contactor between the Inverter and motor to turn the motor ON and OFF during operation. Supplying power to the motor while the Inverter is operating will cause a large surge current to flow, and the Inverter's overcurrent protection function will operate. If a Magnetic Contactor is installed to switch to a commercial power supply, switch the lines only after stopping both the Inverter and the motor. Use the speed search function if switching is required while the motor shaft is rotating.

If a Magnetic Contactor is required for momentary power losses, use a contactor with delayed operation.

Installing Thermal Overload Relays

The Inverter has a protection function using an electronic thermal to protect the motor from overheating. However, if more than one motor is operated from one Inverter or if a multi-pole motor is operated, install Thermal Overload Relays or thermal protectors between the Inverter and motors. Set the constant L1-01 to "1" and set the heat-operating Thermal Overload Relay or thermal protector to 1.0 times the value on the motor nameplate at 50 Hz or 1.1 times the value at 60 Hz.

Improving the Power Factor (Eliminating Phase Advancing Capacitors)

Install a DC or AC Reactor on the power supply line to the Inverter to improve the power factor. (200 V class Inverters of 18.5 to 75kW and 400 V class Inverters of 18.5 to 160kW have built-in DC Reactors.)

Capacitors or surge suppressors on the output line from the Inverter can overheat or be destroyed by the high-frequency component of the Inverter's output. They can also cause overcurrents to flow to the Inverter, causing the overcurrent protection function to activate. Do not install capacitors or surge suppressors in the output line.

Electromagnetic Interference

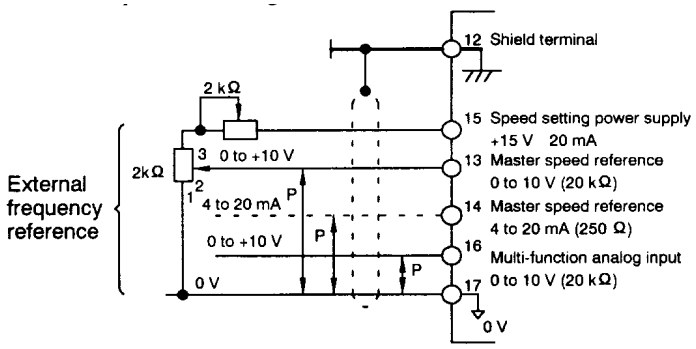
The Inverter's I/O circuits (main circuits) contain a high-frequency component, which may adversely affect communications devices (e.g., AM radios) located nearby. This interference can be reduced by installing noise filter, or you can install the wiring between the Inverter and motor and the power supply wiring in a metal duct and ground the duct.

Wire Sizes and Distances

Motor torque will be reduced by voltage drop along the cable if the distance between the Inverter and the motor is too long. This is particularly noticeable for low-frequency outputs. Use wires of sufficient size.

Always use the optional extension cables when operating the Digital Operator separated from the Inverter. For remote operation using analog signals, keep the control line length between the Analog Operator or operation signals and the Inverter to 50 meters (164 ft) or less, and separate the lines from high-power lines (main circuits or relay sequence circuits) to reduce induction from peripheral devices.

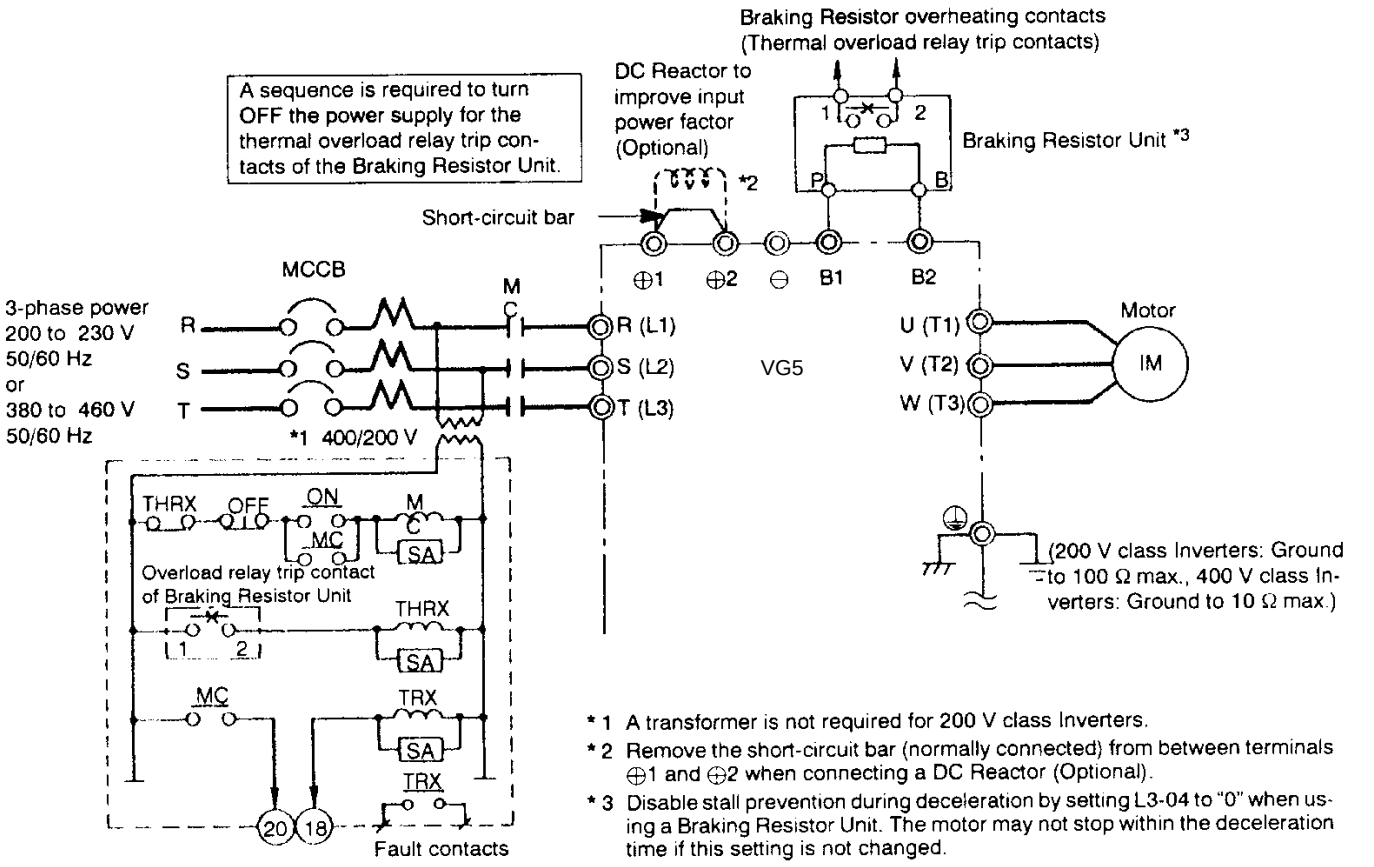
When setting frequencies from an external frequency setter (and not from a Digital Operator), use shielded twisted-pair wires and ground the shield to Terminal 12, as shown in the following diagram.



12.4 Wiring Examples

12.4.1 Using a Braking Resistor Unit

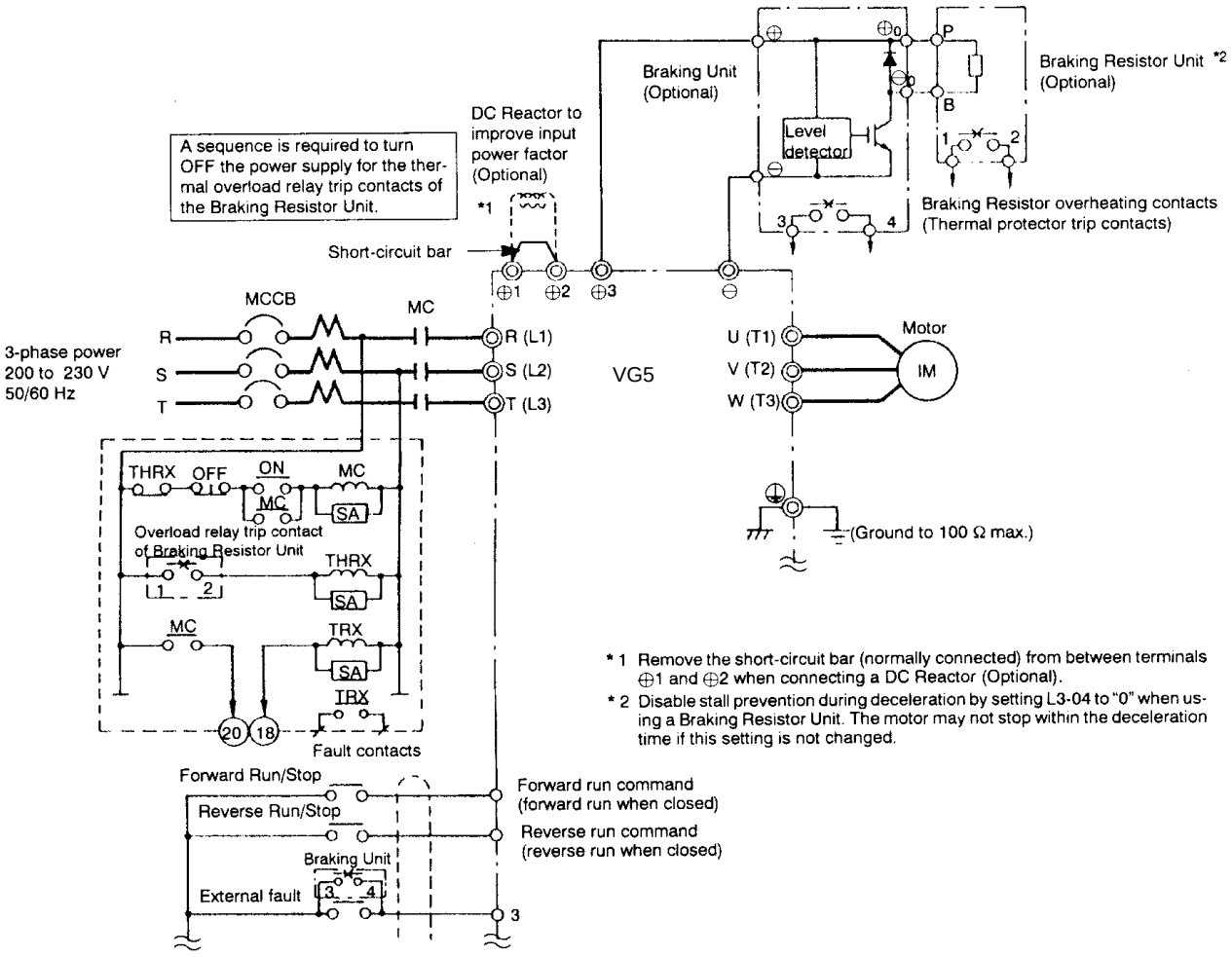
VG520P4 to VG527P5 (200 V class Inverters of 0.4 to 7.5 kW)
VG540P4 to VG54015 (400 V class Inverters of 0.4 to 15 kW)



* 1 A transformer is not required for 200 V class Inverters.
* 2 Remove the short-circuit bar (normally connected) from between terminals ⊕1 and ⊕2 when connecting a DC Reactor (Optional).
* 3 Disable stall prevention during deceleration by setting L3-04 to "0" when using a Braking Resistor Unit. The motor may not stop within the deceleration time if this setting is not changed.

12.4.2 Using a Braking Unit and Braking Resistor Unit

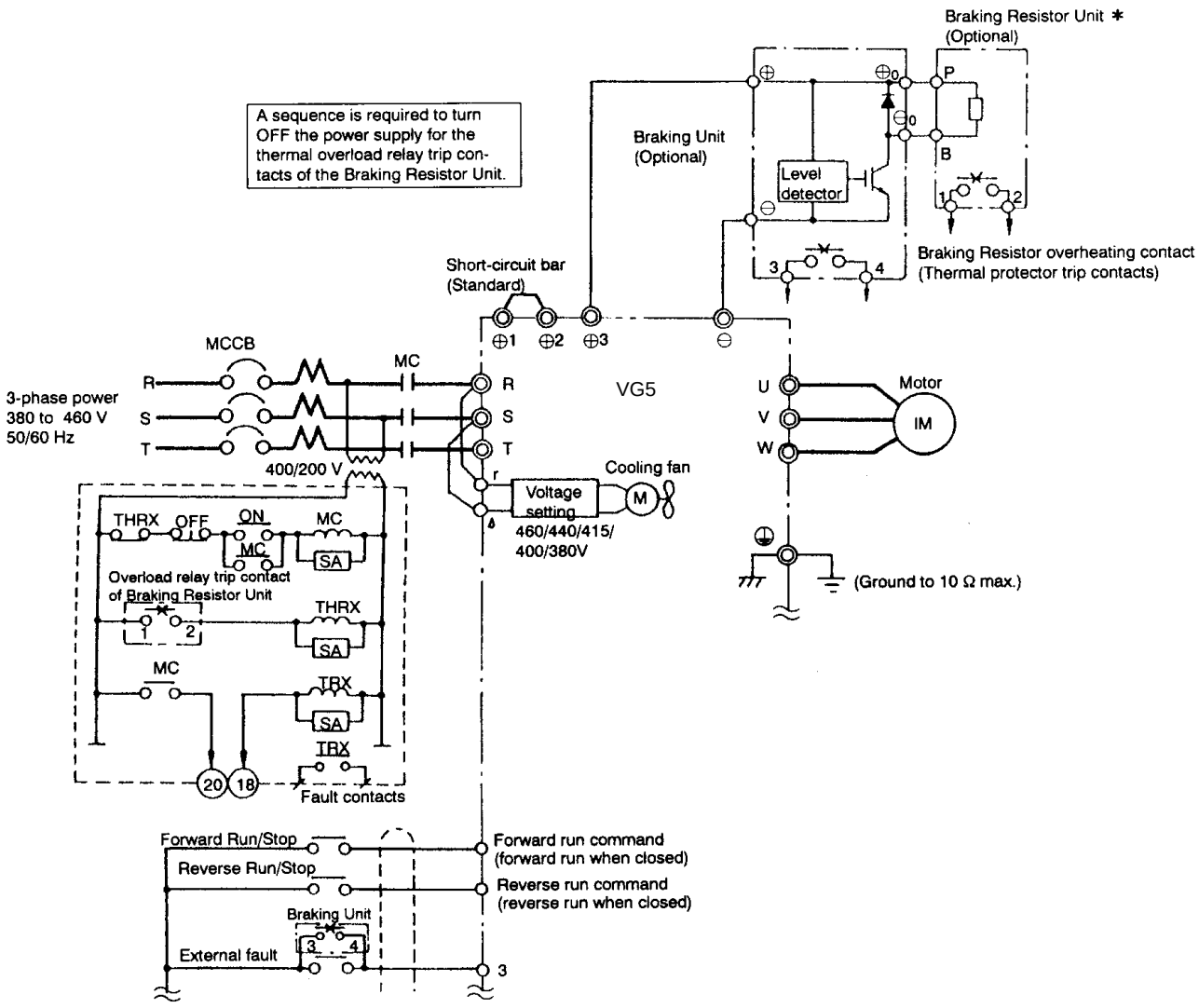
VG52011, VG52015 (200 V class Inverters of 11 kW, 15 kW)



*1 Remove the short-circuit bar (normally connected) from between terminals ⊕1 and ⊕2 when connecting a DC Reactor (Optional).

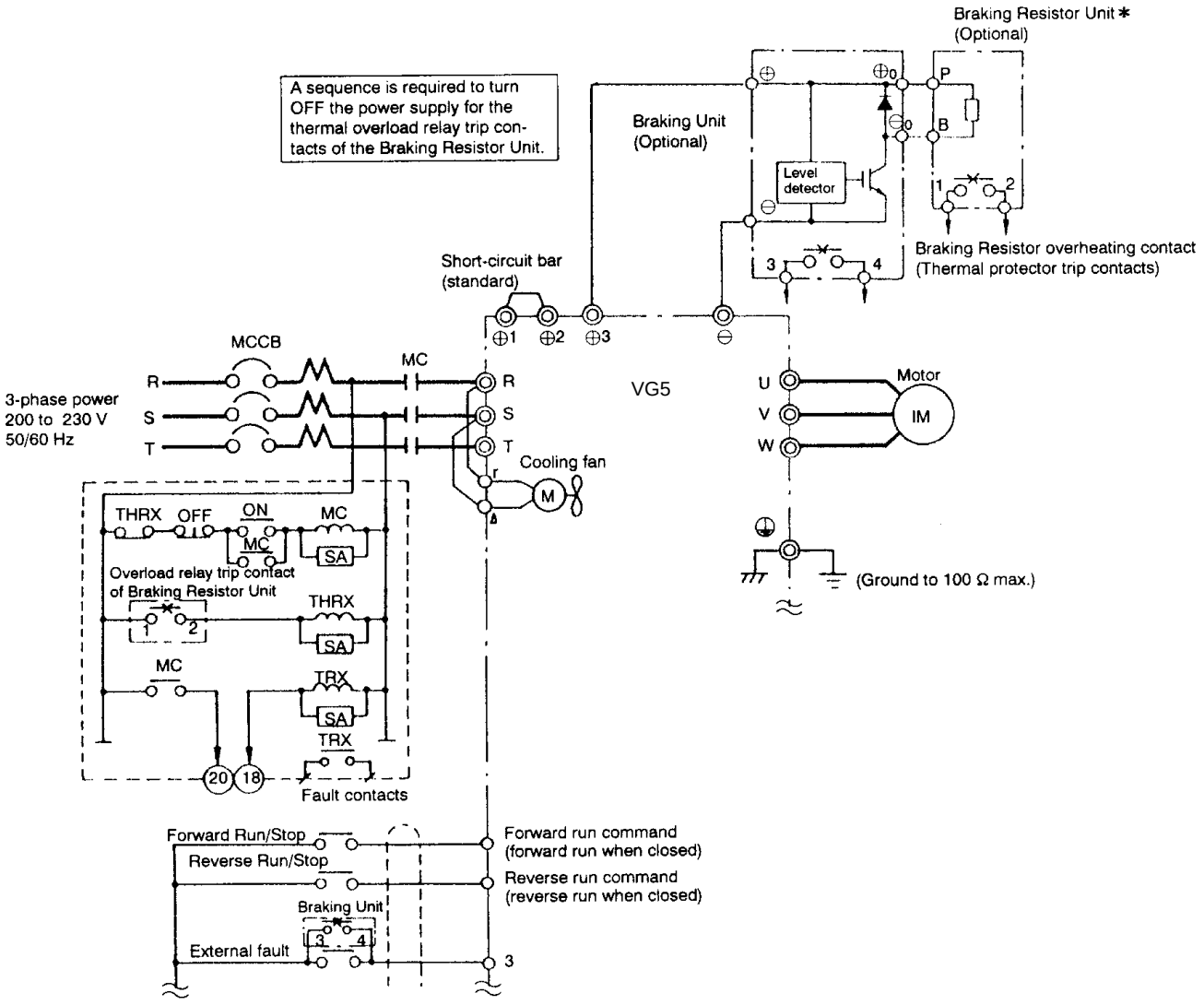
*2 Disable stall prevention during deceleration by setting L3-04 to "0" when using a Braking Resistor Unit. The motor may not stop within the deceleration time if this setting is not changed.

VG52018, VG52022 (200 V class Inverters of 18.5 kW, 22kW)



✱ Disable stall prevention during deceleration by setting L3-04 to "0" when using a Braking Resistor Unit. The motor may not stop within the deceleration time if this setting is not changed.

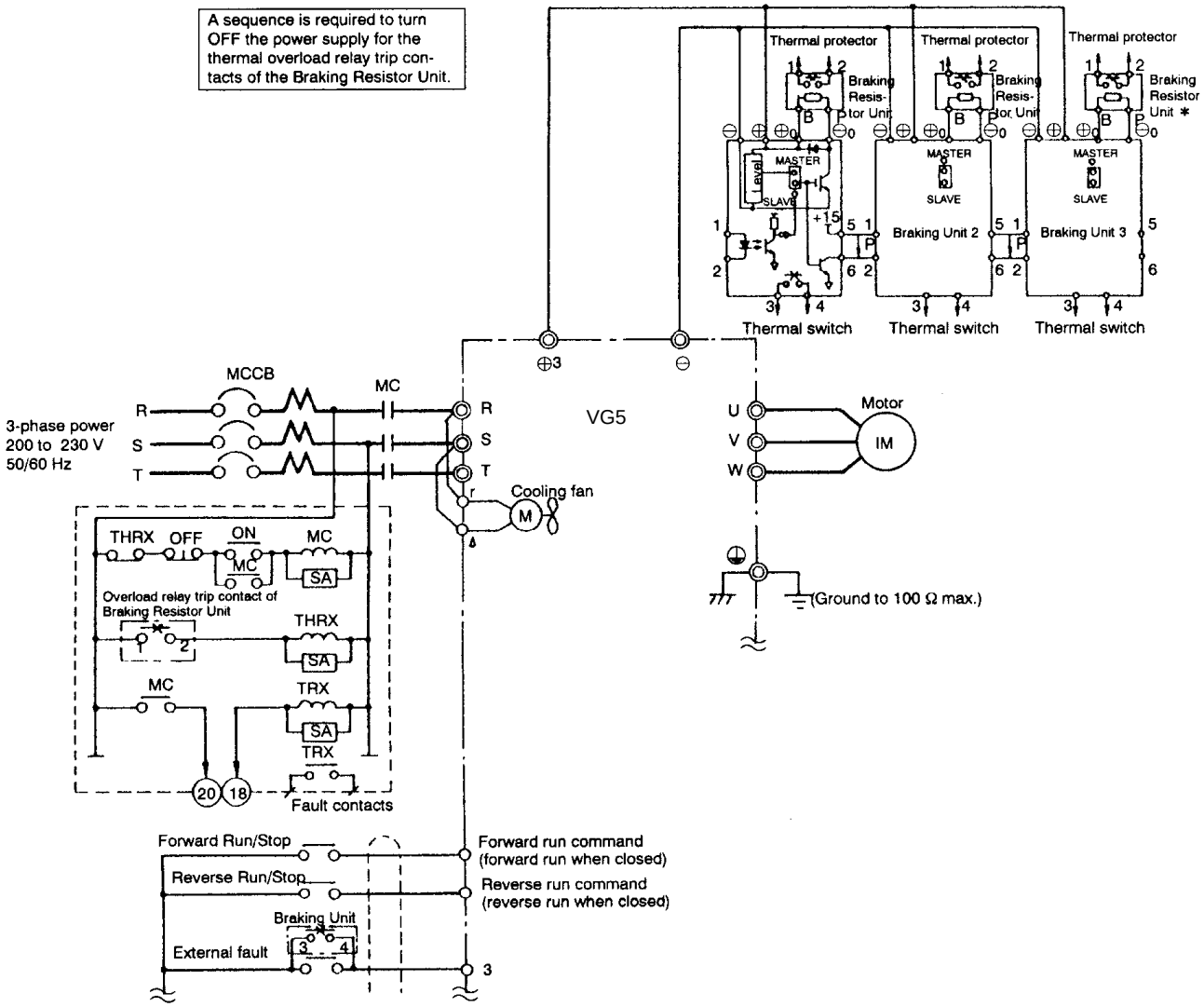
VG54018 to VG54045 (400 V class Inverters of 18.5 to 45 kW)



✱ Disable stall prevention during deceleration by setting L3-04 to "0" when using a Braking Resistor Unit. The motor may not stop within the deceleration time if this setting is not changed.

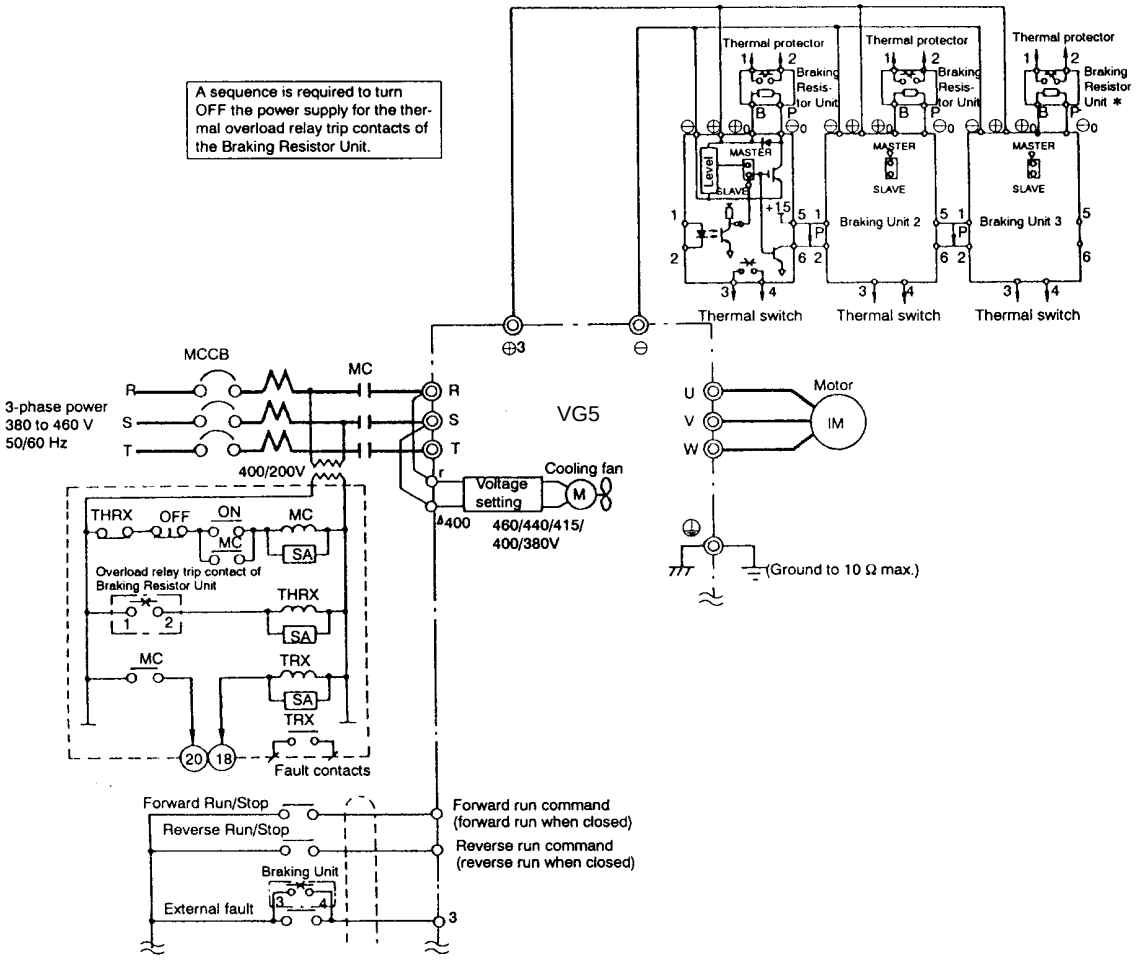
12.4.3 Using Three Braking Units in Parallel

VG52030 to VG52075 (200 V class Inverters of 30 to 75 kW)



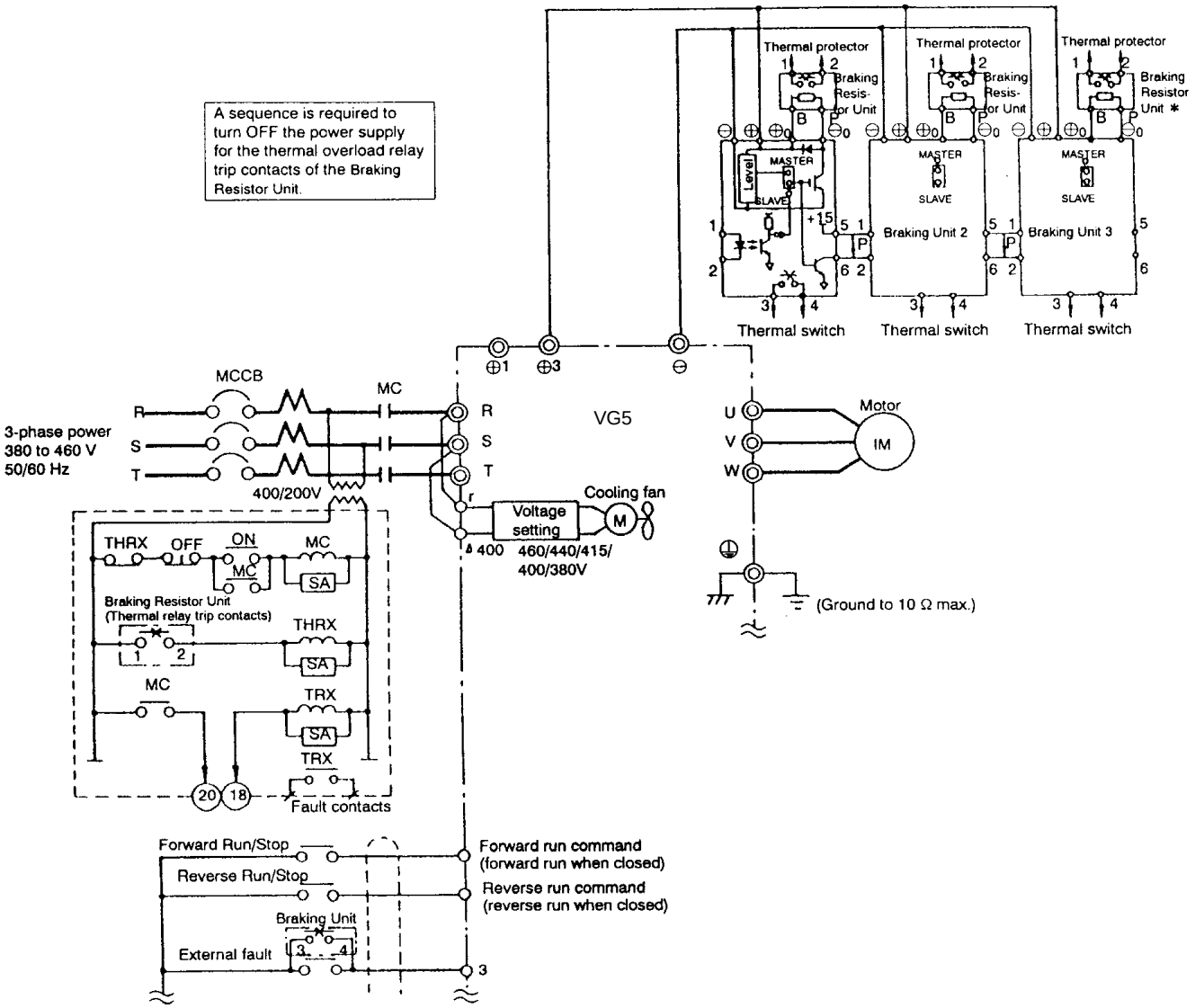
* Disable stall prevention during deceleration by setting L3-04 to "0" when using a Braking Resistor Unit. The motor may not stop within the deceleration time if this setting is not changed.

VG54055 to VG54160 (400 V class Inverters of 55 to 160 kW)



* Disable stall prevention during deceleration by setting L3-04 to "0" when using a Braking Resistor Unit. The motor may not stop within the deceleration time if this setting is not changed.

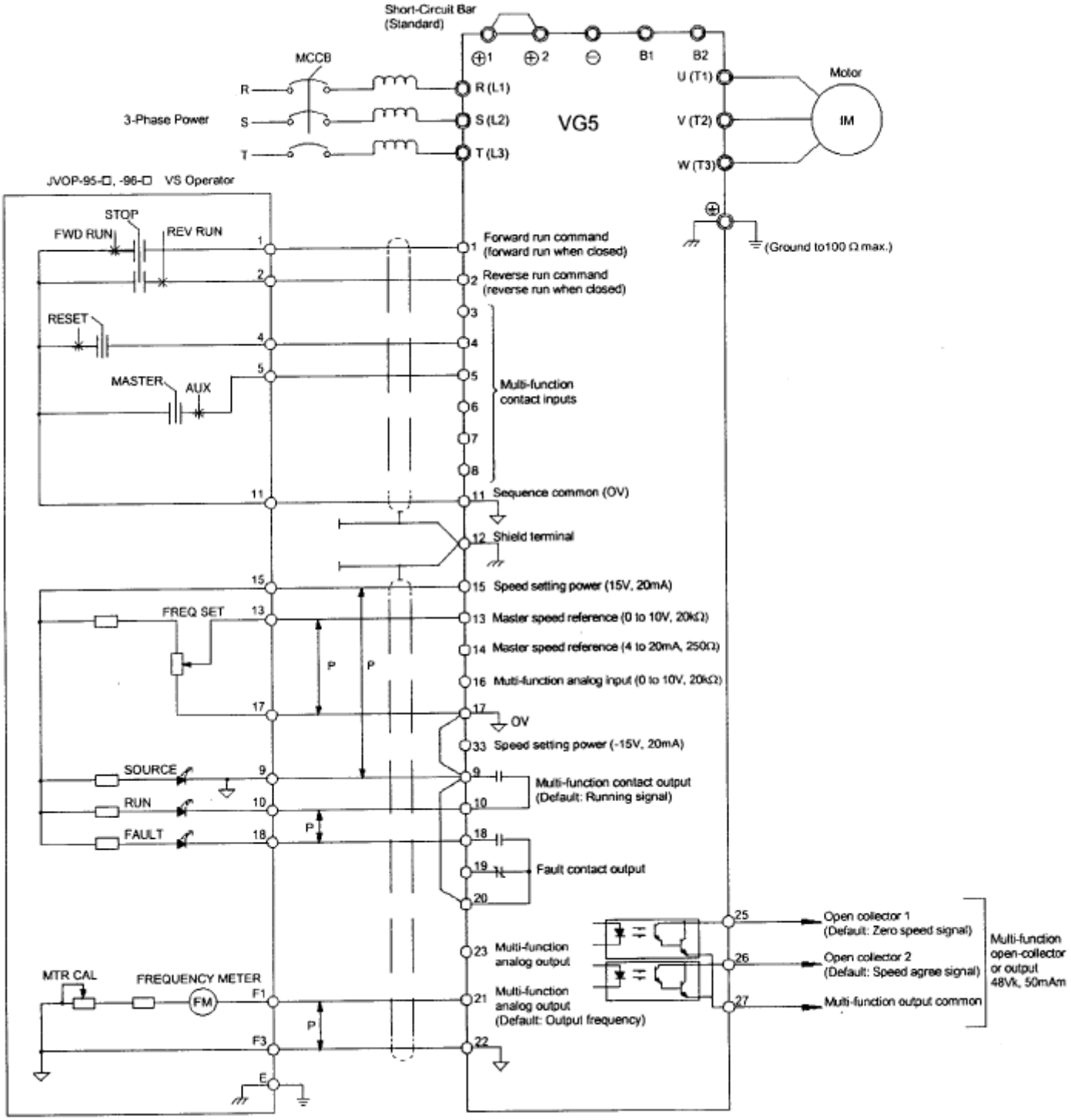
VG54185 to VG54300 (400 V class Inverters of 185 to 300 kW)



* Disable stall prevention during deceleration by setting L3-04 to "0" when using a Braking Resistor Unit. The motor may not stop within the deceleration time if this setting is not changed.

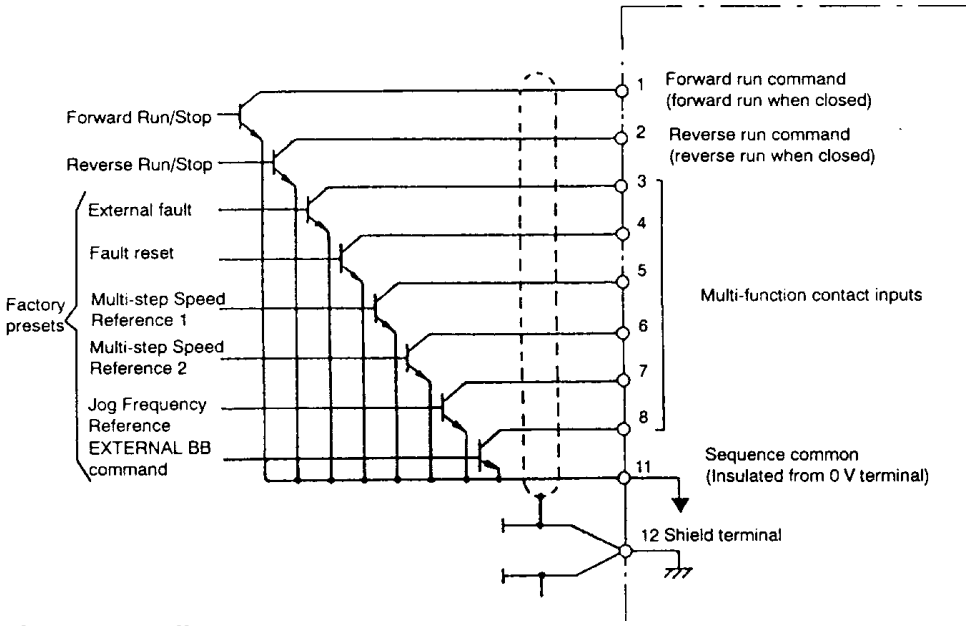
12.4.4 Using a JVOP–95- , –96- VS Operator

VG527P5 (200 V class Inverters of 7.5 kW)



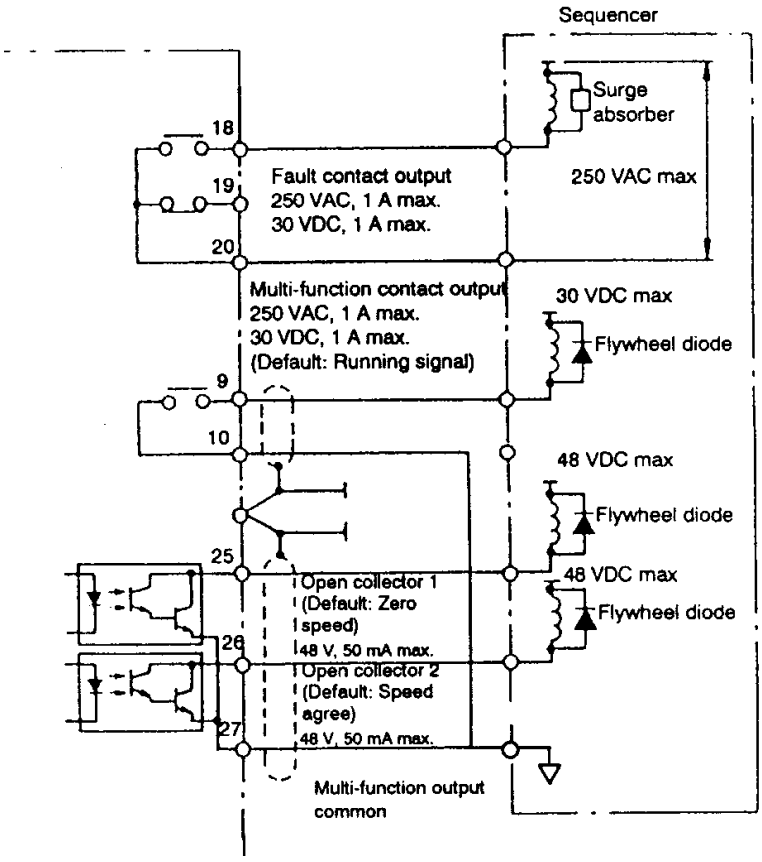
12.4.5 Using an Open-Collector Transistor for Operation Signals

VG527P5 (200 V class Inverters of 7.5 kW)



12.4.6 Using Open-collector, Contact Outputs

VG527P5 (200 V class Inverters of 7.5 kW)



12.5 User Constants

Factory settings are given for a 200 V class Inverter of 0.4 kW set to Open Loop Vector Control (A1-02 = 2)

Table 12.1 User Constants

No.	Name (Display)	Factory Setting	Setting	No.	Name (Display)	Factory Setting	Setting
A1-00	Language selection for Digital Operator (Select Language)	1*1		b6-01	Dwell frequency at start (Dwell Ref @ Start)	0.0	
A1-01	Constant access level (Access Level)	2		b6-02	Dwell time at start (Dwell Time @ Start)	0.0	
A1-02	Control method selection (Control Method)	2*1		b6-03	Dwell frequency at stop (Dwell Ref @ Stop)	0.0	
A1-03	Initialize (Init Parameters)	0		b6-04	Dwell time at stop (Dwell Time @ Stop)	0.0	
A1-04	Password 1 (Enter Password)	0		b7-01	Droop Control gain*2 (Droop Gain)	0.0	
A1-05	Password 2 Select Password)	0		b7-02	Droop Control delay time*2 (Droop Delay Time)	0.05	
A2-01 to A2-32	User setting constant (User Pram 1 to 32)	—		b8-01	Energy Saving gain (Energy Saving Gain)	80	
b1-01	Reference selection (Reference Source)	1		b8-02	Energy Saving frequency (Energy Save Freq)	0.0	
b1-02	Operation method selection (Run source)	1		b9-01	Zero Servo gain (Zero Servo Gain)	5	
b1-03	Stopping method selection (Stopping Method)	0		b9-02	Zero Servo completion width (Zero Servo Count)	10	
b1-04	Prohibition of reverse operation (Reverse Oper)	0		C1-01	Acceleration time 1 (Accel Time 1)	10.0	
b1-05	Operation selection for setting ≦ E1-09 (Zero Speed Oper)	0		C1-02	Deceleration time 1 (Decel Time 1)	10.0	
b1-06	Read sequence input twice (Cntl Input Scans)	1		C1-03	Acceleration time 2 (Accel Time 2)	10.0	
b1-07	Operation after switching to remote mode*2 (LOC/REM RUN Sel)	0		C1-04	Deceleration time 2 (Decel Time 2)	10.0	
b2-01	Zero Speed level/DC Injection Braking start frequency (DCInj Start Freq)	0.5		C1-05	Acceleration time 3 (Accel Time 3)	10.0	
b2-02	DC Injection Braking current (DCInj Current))	50		C1-06	Deceleration time 3 (Decel Time 3)	10.0	
b2-03	DC Injection Braking time at start (DCInj Time @ Start)	0.00		C1-07	Acceleration time 4 (Accel Time 4)	10.0	
b2-04	DC Injection Braking time at stop (DCInj Time @ Stop)	0.50		C1-08	Deceleration time 4 (Decel Time 4)	10.0	
b3-01	Speed search selection at start (SpdSrch at Start)	0*3		C1-09	Emergency stop time (Fast Stop Time)	10.0	
b3-02	Speed search operating current (SpdSrch Current)	100*3		C1-10	Accel/Decel time setting unit (Acc/Dec Units)	1	
b3-03	Speed search deceleration time (SpdSrch Dec Time)	2.0		C1-11	Accel/Decel time switching frequency (Acc/Dec SW Freq)	0.0	
b4-01	Timer function ON-delay time (Delay-ON Timer)	0.0		C2-01	S-curve characteristic time at Acc start (SCrv Acc @ Start)	0.20	
b4-02	Timer function OFF-delay time (Delay-OFF Timer)	0.0		C2-02	S-curve characteristic time at Acc end (SCrv Acc @ End)	0.20	
b5-02	Proportional gain (P) (PID Gain)	1.00		C2-03	S-curve characteristic time at Dec start (SCrv Dec @ Start)	0.00	
b5-03	Integral (I) time (PID I Time)	1.0		C2-04	S-curve characteristic time at Dec end (SCrv Dec @ End)	0.00	
b5-04	Integral (I) limit (PID I Limit)	100.0		C3-01	Slip compensation gain (Slip Comp Gain)	1.0*3	
b5-05	Differential (D) time (PID D Time)	0.00		C3-02	Slip compensation primary delay time (Slip Comp Time)	200*3	
b5-06	PID limit (PID Limit)	100.0		C3-03	Slip compensation limit (Slip Comp Limit)	200	
b5-07	PID offset adjustment (PID Offset)	0.00		C3-04	Slip compensation during regeneration (Slip Comp Regen)	0	
b5-08	PID primary delay time constant (PID Delay Time)	0.00		C3-05	Flux calculation method (Flux Select)	0	

*1 Not initialized. (Japanese standard specifications: A1-01 = 1, A1-02 = 2
*2 Not displayed for some models depending on software version Number.
*3 Factory setting depends on the control method (A1-02).

Table 12.1 User Constants (continued)

No.	Name (Display)	Factory Setting	Setting	No.	Name (Display)	Factory Setting	Setting
C4-01	Torque compensation gain (Torq Comp Gain)	1.00		d3-04	Jump frequency width (Jump Bandwidth)	1.0	
C4-02	Torque compensation time constant (Torq Comp Time)	20*1		d4-01	Frequency reference hold function sel (MOP Ref Memory)	0	
C5-01	ASR proportional (P) gain 1 (ASR P Gain)	20.00*1		d4-02	+ - Speed Limits*2 (Trim Control Lvl)	25	
C5-02	ASR integral (I) time 1 (ASR I Time 1)	0.500*1		d5-01	Torque Control selection (Torq Control Sel)	0	
C5-03	ASR proportional (P) gain 2 (ASR Gain 2)	20.0*1		d5-02	Torque reference delay time (Torq Ref Filter)	0	
C5-04	ASR integral (I) time 2 (ASR I Time 2)	0.500*1		d5-03	Speed limit selection (Speed Limit Sel)	1	
C5-05	ASR limit (ASR Limit)	5.0		d5-04	Speed limit (Speed Lmt Value)	0	
C5-06	ASR primary delay time (ASR Delay Time)	0.004		d5-05	Speed limit bias (Speed Lmt Bias)	10	
C5-07	ASR switching frequency (ASR Gain SW Freq)	0.0		d5-06	Speed Torque Control switching timer (Ref Hold Time)	0	
C5-08	ASR integral (I) limit*2 (ASR I Limit)	400		E1-01	Input voltage setting (Input Voltage)	200*4	
C6-01	Carrier frequency upper limit (Carrier Freq Max)	15.0*3		E1-02	Motor selection (Motor Selection)	0	
C6-02	Carrier frequency lower limit (Carrier Freq Min)	15.0*3		E1-03	V/f pattern selection (V/f Selection)	0F	
C6-03	Carrier frequency proportional gain (Carrier Freq Gain)	0*3		E1-04	Max. output frequency (Max Frequency)	60.0	
C7-01	Hunting Prevention selection (Hunt Prev Select)	1		E1-05	Max voltage (Max Voltage)	200.0*4	
C7-02	Hunting Prevention Gain (Hunt Prev Gain)	1.00		E1-06	Base frequency (Base Frequency)	60.0	
C8-08	AFR gain (AFR Gain)	1.00		E1-07	Mid. output frequency (Mid Frequency A)	3.0*1	
C8-09	Speed feedback detection AFR time*2 (AFR Time)	50		E1-08	Mid. output frequency voltage (Mid Voltage A)	11.0*1*4	
C8-30	Carrier frequency during Auto-Tuning*2 (Carrier in tune)	2		E1-09	Min. output frequency (Min Frequency)	0.5*1	
d1-01	Frequency reference 1 (Reference 1)	0.00		E1-10	Min. output frequency voltage (Min Voltage)	2.0*1*4	
d1-02	Frequency reference 2 (Reference 2)	0.00		E1-11	Mid. output frequency 2*2 (Mid Frequency B)	0.0	
d1-03	Frequency reference 3 (Reference 3)	0.00		E1-12	Mid. output frequency voltage2*2 (Mid Voltage B)	0.0	
d1-04	Frequency reference 4 (Reference 4)	0.00		E1-13	Base voltage*2 (Base Voltage)	0.0	
d1-05	Frequency reference 5 (Reference 5)	0.00		E2-01	Motor rated current (Motor Rated FLA)	1.90*3	
d1-06	Frequency reference 6 (Reference 6)	0.00		E2-02	Motor rated slip (Motor Rated Slip)	2.90*3	
d1-07	Frequency reference 7 (Reference 7)	0.00		E2-03	Motor no-load current (No-Load Current)	1.20*3	
d1-08	Frequency reference 8 (Reference 8)	0.00		E2-04	Number of motor poles (Number of Poles)	4	
d1-09	Jog frequency reference (Jog Reference)	6.00		E2-05	Motor line-to-line resistance (Term Resistance)	9.842*3	
d2-01	Frequency reference upper limit (Ref Upper Limit)	100.0		E2-06	Motor leak inductance (Lead Inductance)	18.2*3	
d2-02	Frequency reference lower limit (Ref Lower Limit)	0.0		E2-07	Motor iron-core saturation coefficient 1 (Saturation Comp 1)	.50	
d3-01	Jump frequency 1 (Jump Freq 1)	0.0		E2-08	Motor iron-core saturation coefficient 2 (Saturation Comp 2)	0.75	
d3-02	Jump frequency 2 (Jump Freq 2)	0.0		E2-09	Motor mechanical loss (Mechanical Loss)	0.0	
d3-03	Jump frequency 3 (Jump Freq 3)	0.0		E3-01	Motor 2 control method seleciton*1 (Control Method)	2	

*1 Factory setting depends on the control method (A1-02).
*2 Not displayed for some models depending on software version number.
*3 Setting unit and initial setting depend on the Invert capacity.
*4 Setting for 200 V class Inverters. For 400 V class Inverters, double the value.

Table 12.1 User Constants (continued)

No.	Name (Display)	Factory Setting	Setting
E4-01	Motor 2 max. output frequency*1 (V/F2 Max Freq)	60.0	
E4-02	Motor 2 max voltage*1 (V/F2 Max Voltage)	200.0*2	
E4-03	Motor 2 max voltage frequency*1 (V/F2 Base Freq)	60.0	
E4-04	Motor 2 mid. output frequency 1*1 (V/F2 Mid Freq)	3.0	
E4-05	Motor 2 mid output freq. voltage 1*1 (V/F2 Mid Voltage)	11.0*2	
E4-06	Motor 2 min. output frequency (V/F2 Min Freq)	0.5	
E4-07	Motor 2 min. output frequency voltage*1 (V/F2 Min Voltage)	2.0*2	
E5-01	Motor 2 rated current*1 (Motor 2 Rated FLA)	1.9*3	
E5-02	Motor 2 rated slip*1 (Motor 2 Slip Freq)	2.90*3	
E5-03	Motor 2 no-load current*1 (Motor 2 No-load I)	1.20*3	
E5-04	Motor 2 number of poles*1 (Motor 2 # Poles)	4 poles	
E5-05	Motor 2 line-to-line resistance*1 (Motor 2 Term Ohms)	9.842*3	
E5-06	Motor 2 leak inductance*1 (Motor 2 Leak)	18.2*3	
F1-01	PG constant (PG Pulse/Rev)	600	
F1-02	Operation selection at PG open circuit (PG Fdbk Loss Sel)	1	
F1-03	Operation selection overspeed PG Overspeed Sel)	1	
F1-04	Operation selection at deviation (PG Deviation Sel)	3	
F1-05	PG rotation (PG Rotation Sel)	0	
F1-06	PG division rate/PG pulse monitor (PG Output Ratio)	1	
F1-07	Integral value during accel/decel enable/disable (PG Ramp PI/I Sel)	0	
F1-08	Overspeed detection level (PG Overspd Level)	115	
F1-09	Overspeed detection delay time (PG Overspd Time)	0.0*4	
F1-10	Excess. speed deviation detection level (PG Deviate Level)	10	
F1-11	Excess. speed deviation delay time (PG Deviate Time)	0.5	
F1-12	Number of PG gear teeth 1 (PG# Gear Teeth 1)	0	
F1-13	Number of PG gear teeth 2 (PG# Gear Teeth 2)	0	
F1-14	PG open-circuit detection time*1 (PGO Time)	2.0	
F2-01	Bi-polar or uni-polar input selection (AI-14 Input Sel)	0	
F3-01	Digital input option (DI Input)	0	
F4-01	Channel 1 monitor selection (AO Ch1 Select)	2	
F4-02	Channel 1 gain (AO Ch1 Gain)	1.00	
F4-03	Channel 2 monitor selection (AO Ch2 Select)	3	
F4-04	Channel 2 gain (AO Ch2 Gain)	0.50	
F5-01	Channel 1 output selection (DO-02 Ch1 Select)	0	
F5-02	Channel 2 output selection (DO-02 Ch2 Select)	1	
F6-01	Output mode selection (DO-08 Selection)	0	
F7-01	Frequency multiple selection (PO-36F Selection)	1	
F8-01	Transmission option/SI-F/G*1 (E-15 Det Sel)	1	
F9-01	External fault input level from transmission option (FF0 Selection)*1	0	
F9-02	External fault detection from transmission option (EF0 Detection)*1	0	
F9-03	Action for external fault from transmission option (EF0 Fault Act)*1	1	
F9-04	Transmission option trace sampling time (Trace Sample Time)*1	0	
H1-01	Multi-function input/Terminal 3 (Terminal 3 Sel)	24	
H1-02	Multi-function input/Terminal 4 (Terminal 4 Sel)	14	
H1-03	Multi-function input/Terminal 5 (Terminal 5 Sel)	3(0)*5	
H1-04	Multi-function input/Terminal 6 (Terminal 6 Sel)	4(3)*5	
H1-05	Multi-function input/Terminal 7 (Terminal 7 Sel)	6(4)*5	
H1-06	Multi-function input/Terminal 8 (Terminal 8 Sel)	8(6)*5	
H2-01	Multi-function input/Terminals 9-10 (Terminal 9 Sel)	0	
H2-02	Multi-function input/Terminals 25-27 (Terminal 25 Sel)	1	
H2-03	Multi-function input/Terminals 26-27 (Terminal 26 Sel)	2	
H3-01	Signal level selection/Terminal 13 (Term 13 Signal)	0	
H3-02	Gain/Terminal 13 (Terminal 13 Gain)	100.0	
H3-03	Bias/Terminal 13 (Terminal 13 Bias)	0.0	
H3-04	Signal level selection/Terminal 16 (Term 16 Signal)	0	
H3-05	Multi-function analog input/Terminal 16 (Terminal 16 Sel)	0	
H3-06	Gain/Terminal 16 (Terminal 16 Gain)	100.0	
H3-07	Bias/Terminal 16 (Terminal 16 Bias)	0.0	
H3-08	Signal level selection/Terminal 14 (Term 14 Signal)	2	
H3-09	Multi-function analog input/Terminal 14 (Terminal 14 Sel)	1F	
H3-10	Gain/Terminal 14 (Terminal 14 Gain)	100.0	
H3-11	Bias/Terminal 14 (Terminal 14 Bias)	0.0	
H3-12	Analog input filter time constant (Filter Avg Time)	0.00	

*1 Not displayed for some models depending on software version number.
*2 Setting for 200 V class Inverters. For 400 V class Inverter, double the value.
*3 Setting unit and initial setting depend on Inverter capacity.
*4 Depends on the control method (A1-02).
*5 Factory setting in the parentheses is for 3-wire sequence.

Table 12.1 User Constants (continued)

No.	Name (Display)	Factory Setting	Setting	No.	Name (Display)	Factory Setting	Setting
H4-01	Monitor Selection/Terminal 21 (Terminal 21 Sel)	2		L5-01	Number of Auto Restart attempts (Num of Restarts)	0	
H4-02	Gain/Terminal 21 (Terminal 21 Gain)	1.00		L5-02	Auto Restart operation selection (Restart Sel)	0	
H4-03	Bias/Terminal 21 (Terminal 21 Bias)	0.0		L6-01	Torque detection selection 1 (Torq Det 1 Sel)	0	
H4-04	Monitor selection/Terminal 23 (Terminal 23 Sel)	3		L6-02	Torque detection level 1 (Torq Det 1 Lvl)	150	
H4-05	Gain/Terminal 23 (Terminal 23 Gain)	0.50		L6-03	Torque detection time 1 (Torq Det 1 Time)	0.1	
H4-06	Bias/Terminal 23 (Terminal 23 Bias)	0.0		L6-04	Torque detection selection 2 (Torq Det 2 Lvl)	0	
H4-07	Analog output signal level selection (AO Level Select)	0		L6-05	Torque detection level 2 (Torq Det 2 Lvl)	150	
H5-01	Station address (Serial Comm Adr)	1F		L6-06	Torque detection time 2 (Torq Det 2 Time)	0.1	
H5-02	Communication speed selection (Serial Baud Rate)	3		L7-01	Forward torque limit (Torq Limit Fwd)	200	
H5-03	Communication parity selection (Serial Com Sel)	0		L7-02	Reverse torque limit (Torq Limit Rev)	200	
H5-04	Stopping method after communication error (Serial Fault Sel)	3		L7-03	Forward regenerative torque limit (Torq lmt Rev Rgn)	200	
H5-05	Communication error detection sel.*1 (Serial Flt Dtct)	1		L7-04	Reverse regenerative torque limit (Torq Lmt Rev Rgn)	200	
L1-01	Motor protection selection (MOL Fault Select)	1		L8-01	Protect selection for internal DB resistor ((DB Resistor Port)	0	
L1-02	Motor protection time constant (MOL Time Const)	1.0		L8-02	Overheat pre-alarm level ((OH Pre-Alarm Lvl)	95	
L2-01	Momentary power loss detection (PwrL Selection)	0		L8-03	Operation selection after overheat pre-alarm (OH Pre-Alarm Sel)	3	
L2-02	Momentary power loss ridethru time (PwrL Baseblock t)	0.5*2		L8-05	Input open-phase protection selection (Ph Loss In Sel)	0	
L2-03	Min. baseblock time (PwrL Baseblock t)	0.5*2		L8-07	Output open-phase protection selection (Ph Loss Out Sel)	0	
L2-04	Voltage recovery time (PwrL V/F Ramp t)	0.3*2		o1-01	Monitor selection (Motor Select)	6	
L2-05	Undervoltage detection level (PUV Det Level)	190*3		o1-02	Monitor selection after power up (Power-On Monitor)	1	
L2-06	KEB deceleration rate (KEB Frequency)	0.0		o1-03	Frequency units of ref setting/monitor (Display Scaling)	0	
L3-01	Stall Prevention selection during accel (StallP Accel Sel)	1		o1-04	Frequency units of constant setting (Display Units)	0	
L3-02	Stall Prevention level during accel (StallP Accel Lvl)	150		o1-05	Constant number display selection (Address Display)	0	
L3-03	Stall prevention limit during accel (StallP CHP Lvl)	50		o2-01	LOCAL/REMOTE key enable/disable (LOCAL/REMOTE Key)	1	
L3-04	Stall Prevention selection during running (StallP Decel Sel)	1		o2-02	STOP key during control circuit terminal operation (Oper STOP Key)	1	
L3-05	Stall Prevention selection during running (StallP Run Sel)	1		o2-03	User constant initial value (User Defaults)	0	
L3-06	Stall Prevention level during running (StallP Run Level)	160		o2-04	kVA selection (Inverter Model #)	0*2	
L4-01	Speed agree detection level (Spd Agree Level)	0.0		o2-05	Frequency reference setting method*1 (Operator M.O.P.)	0	
L4-02	Speed agree detection width (Spd Agree Width)	2.0		o2-06	Operation selection when Digital Operator is disconnected (Oper Detection)	0	
L4-03	Speed agree detection level (+/-) (Spd Agree Lvl + -)	0.0		o2-07	Cumulative operation time setting (Elapsed Time Set)	—	
L4-04	Speed agree detection width (+/-) (Spd Agree Wdth + -)	2.0		o2-08	Cumulative operation time selection (Elapsed Time Run)	0	
L4-05	Operation when freq reference missing (Ref Loss Sel)	0		o2-09	Initialize mode selection*1 (Init Mode Sel)	0*4	

*1 Not displayed for some models depending on software version number.
*2 Setting unit and initial setting depend on Inverter capacity.
*3 Setting for 200 V class Inverters. For 400 V class Inverters, double the value.
*4 Not initialized. (Japanese standard specification is o2-09 = 0.)

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