TOSHIBA

E6581530②

TOSVERT VF-AS1

Instruction manual with V3 motor

VFAS1+Vector option[VEC007Z] with V3 motor

- Contents -

1. Comparison with VF-V3 (VFAS1+PG feedback)

[Specifications, functions]

Series name			TOSVERT VF-AS1 + PG feedback option	TOSVERT VF-V3
Output capacity			200V: 0.4 ~ 75kW 400V: 0.75 ~ 500kW	200V: 2.2 ~ 55kW
Overload rating			150%-60sec	150%-60sec, 200%-2sec (up to 11kW)
Control method			PWM control [Vector control, Digital current control for all range]	PWM control [Vector control, Digital current control for all range]
Control function			Speed/ Torque	Speed/ Torque/ Positioning
Main power supply		200V class	3ph- 200~240V-50/60Hz	3ph- 200~220V-50/60Hz
		400V class	3ph-380~480V-50/60Hz over 110kW: 3ph-380~440-50Hz 3ph-380~480-60Hz	-
Rated Speed			60Hz/1800 min^{-1} (4 pole) *1	1500min^{-1}
Maximum motor speed			80Hz/2400 min^{-1} (4 pole) *1	2400min^{-1}
Maximum output frequency			80Hz *2	80Hz
Speed control		Speed control range	1:1000	1:1000
		Speed rate of change	Digital setting: +/-0.01% Analog setting: +/-0.3%	Digital setting: +/-0.01% Analog setting: +/-0.1%
		Speed instruction input	0 - +/-10Vdc / Maximum speed 0 - +10Vdc / Maximum speed 4-20mAdc / Maximum speed	0 - +/-10Vdc / Maximum speed (Possible to adjust internal setting)
Positioning control		Kind of input pulse	Impossible to use a positioning control.	Forward pulse / reverse pulse sequence
		Maximum frequency		160kpps
		Electronic gear setup		100 ~ 400 ppr / 1 rotation
Torque control / Torque operation input			0 - +/-10Vdc	0 - +/-10Vdc
Control function	Acceleration/ Deceleration time setting		0.1-6000sec(Straight/ S character)	0.0-60.0sec(Straight/ S character)
	Switching control mode		Possible to switch	Possible to switch
	Preset speed		15 preset speed maximum	3 preset speed
	Braking method		Dynamic brake(resistor) or Re-generating to power supply by RC7 series * Braking resistor: Option	Dynamic brake(resistor) or Re-generating to power supply by RC7 series * Resistor is option devices over 22kW
	Torque limit(Current limiting function)		Possible to adjust internal setting or external signal. Without temperature compensation	Possible to adjust internal setting or external signal. With temperature compensation
	Speed limit		-	Electronic gear(for positioning control)
	Snap stop control		Enabled to use torque limit function	Enabled
	Trip history monitor		Before the past 4 times	Before the past 8 times
	Applied load GD2		100 or less times of a motor GD2	20 or less times of a motor GD2
	PWM carrier frequency		1.0 ~ 16.0kHz over 200V-55kW, 400V-90kW 2.5 ~ 8.0kHz	up to 11kW: 8kHz fixed over 15kW: 2kHz fixed
Contact output signal	Low speed detection		Low speed detection	Low speed detection
	Reach fixed speed/ finished positioning		Reach fixed speed/-	Reach fixed speed/ finished positioning
	Standby		Standby	Standby
	Current limiting		Over torque alarm	Current limiting
	Fault		Fault (All trip code or without EF, OCL trip) [1c relay output, open collector output]	Fault (All trip code) [Open collector output] OFF: Fault ON: Normal
	Fault code		Fault code (2 bit + 4(option) bit)	Fault code(4 bit)
	Positioning/ Speed feed back pulse output		-	Encoder signal (A, B phase: 1000ppr, Z phase: 1ppr)

*1 Depends on Motor design and setting of carrier frequency

*2 Possible control up to 120Hz with vector control with specific motor

(Possible control 500Hz with V/f control.)

*3 VFAS1's software version (CPU1 version) should be over V124 (shipped after Mar,2006).

*4 VFAS1 doesn't support a positioning control function.

Series name	TOSVERT VF-AS1 + PG feedback option	TOSVERT VF-V3
Analog output	2 output circuit(0-10V) + 2 output by option(+/-10V, 0-20mA) (Select from 64 functions)	2 output(+/-10V) (Speed/ torque or Torque / output current)
Adjust method	7 touch key operation with operation panel	5 touch key operation + 1 reset switch
Monitor	7 segment LED	7 segment LED
Monitoring function	- Frequency at trip - Status - Output frequency - Operation frequency - Output current - DC-bus voltage - Output voltage - Compensated frequency - Speed feedback (real time) - Speed feedback (1 sec filtering) - Output torque - Operation torque - Exciting current - PID feedback value - Motor overload rate - Inverter overload rate - PBR overload rate - Input power - Output power - RR input - VI/II input - RX input - AI1 input - FM output - AM output - Fixed output for meter adjustment - Input terminal Info. - Output terminal Info. - CPU1 version - CPU2 version - Past trip 1~4 - Part replacement alarm - Cumulative operation time etc.	- Standby ON/OFF indication - Operation speed - Speed - Torque - Information of input terminal - History of trip
Protection	- Over current while acceleration - Over current while deceleration - Over current while constant speed - Over current when starting - U-arm over current - V-arm over current - W-arm over current - Input phase failure - Output phase failure - Over voltage while acceleration - Over voltage while deceleration - Over voltage while constant speed - Over load for inverter - Over load for motor - Over heat - Emergency stop - Failure of EEPROM - PBR over current - PBR over load - Failure of CPU - Failure of communication command - Failure of SINK/SOURCE switching - Failure of operation keys - Failure of current detection circuit - Failure of optional devices - Low output current - Low input voltage(Main power/ Control power) - Over torque - Earth fault - Failure of auto-tuning - Failure of inverter's type-form - Failure of initialize - Failure of RAM - Failure of ROM - Failure of CPU1 - Failure of CPU2 etc.	- Over Current - Over voltage - Low input voltage - Over load - Over heat/ Failure of regeneration - Failure of sensor - Over speed - Over Position deviation - Motor restraint - Over travel - Failure of parameter setting
Communication	RS485 standard (Toshiba protocol, MODBUS-RTU) OPTIONAL devices: DeviceNet Profibus-DP, CC-LINK etc.	RS232C, RS485 with Optional device "P CU10(card for positioning)"
Standard	CE, UL	none
SINK/ SOURCE switching	Enabled	none

[Comparison of characteristics]

Series name		TOSVERT VF-AS1 + PG feedback option	TOSVERT VF-V3
Control method		Current vector control	Current vector control
Vector control with sensor		PG feedback (*1), Without temperature sensor	PG feedback with temperature sensor
Starting torque		0Hz-200% Sensor-less: 0.5Hz-200%	up to 11kW: 0Hz-200% over 15kW: 0Hz-150%
Zero speed torque	Motoring	Enable	Enable
	Regenerating	Enable (Disable when sensor-less)	Enable
Speed presumption system		Slip frequency presumption from torque current	Slip frequency presumption from torque current
Speed control range		1:1000 Sensor-less 1:200 *2	1:1000 (only PG feedback)
Speed control accuracy (Digital setting)		+/-0.02% *3 Sensor-less +/-0.5% *4	+/-0.01% (only PG feedback)
Speed response		~ 90 rad/s Sensor-less ~90rad/s *5	60rad/s
PG specifications		- 1000ppr - Line drive system(5V) or Complementary(12V, 15V, 24V) - 300kHz of maximum input pulse frequency	- 1000oor - Line drive system(5V) - 40kHz(60kHz) of maximum input pulse frequency
Torque control		Enable without temperature compensation	Enable
Torque control range (Torque value)		-100~100%	-100~100%
Speed response while torque control		All range	All range
Accuracy of torque control		+/-10% (When motor temperature is hot.)	+/-10% (With motor temperature detection)
Speed range of torque limit	Motoring	All range (Sensor-less 1:100) *6	All range
	Regenerating	All range (Sensor-less 1:50) *6	
Auto-restart		Enable	Enable only speed or torque control
Regenerative power ride-though control		Enabled	none

*1 VF-AS1: The inverter's capacity is larger than motor's (1 rank-up)

*2 VF-AS1: This is over 3.7kW of inverter and motor capacity. (Depends on rated slip frequency)

*3 VF-AS1: The base frequency is 60Hz setting.

*4 VF-AS1: About 10% of rated slip

*5 Fine-tuned relation parameter.

*6 Sample value because these range depend on the motor characteristics.

2. Combination with the motor only for VFV3

The VF-AS1 is possible to operate V3 motor with next optional devices.

[Speed control, Torque control]
Vector control option with sensor: VEC007Z
* VFAS1's software version (CPU1 version) should be over V124 (shipped after Mar,2006).

[NOTICE]
- The VF-AS1's capacity is larger than V3 motor's. (1 rank or 2 rank-up)
- To install dynamic braking resistor(option) when the machine need large regenerative torque.
  It is necessary to install large capacity of resistor in next condition.
  1. Short time cycle of acceleration and deceleration
  2. Large load inertia
- The VEC004~6Z can't use for V3 motor which PG specifications is line driver output.
- **VFAS1 doen't support a positioning control function.** Therefore, VFAS1 combination with the V3 motor can't perform a positioning control.

[Table of VFAS1 and V3 motor combination]

Output capacity (kW)	V3 motor's type-form	Case number	VFAS1 specifications	VFV3 specifications
2.2	IK-EBKM8-VFV3	100L	VFAS1-2037PL	VFAS1-2055PL
3.7	IK-EBKM8-VFV3	112M	VFAS1-2055PL	VFAS1-2075PL
5.5	IKK-EBKM8-VFV3	132S	VFAS1-2075PL	VFAS1-2110PM
7.5	IKK-EBKM8-VFV3	132M	VFAS1-2110PM	VFAS1-2150PM
11	IKK-EBKM8-VFV3	160M	VFAS1-2150PM	VFAS1-2185PM
15	IKK-EBKM8-VFV3	160L	VFAS1-2185PM	VFAS1-2220PM
22	TIK-EBKM8-VFV3	180M	VFAS1-2300PM	VFAS1-2370PM
30	TIK-EBKM8-VFV3	180L	VFAS1-2370PM	VFAS1-2450PM
37	TIK-EBKM8-VFV3	200L	VFAS1-2450PM	VFAS1-2550P
45	TIK-EBKM8-VFV3	200L	VFAS1-2550P	VFAS1-2750P
55	TIK-EBKM8-VFV3	225S	VFAS1-2750P	-

*1 The type-form of V3 motor is Leg attachment type.
*2 Load reduction may be needed.

VFAS1 specifications: Overload rating: 150%-1min
VFV3 specifications: Overload rating: 150%-1min, 215%-0.5sec. The starting torque is 200%~300%.

2.1 Parameter settings

To use VFAS1 with V3 motor, these parameter setting are needed.

* It is necessary to set others parameter for torque control.

[Parameter setting for motor]

About motor setting parameter, please execute auto-tuning by next method.

(1) Set next parameter by motor's name plate.

Title	Function	Setting range	Setting value
uL	Base frequency	25.0 - 500 Hz	52
uLu	Voltage at base frequency	50 - 330 V / 50 – 660 V	160
F405	Motor rated capacity *1	0.10 - 500 kW	Depends on capacity
F406	Motor rated current	0.1 - 2000 A	Depends on capacity
F407	Motor rated rotation	100 - 60000 min^{-1}	Depends on capacity

*1: Set using VFV3 motor's capacity.

(2) Please execute F400(Auto-tuning 1) = 4 (Auto calculation of motor const)

(3) After motor wiring, please set F400 = 2(Auto-tuning and run) and input the operation signal.

The motor const setting is finished above method.

[Parameter setting]

Title	Function	Setting range	Setting value
Pt	Selection of V/f control	0 - 8	8
OLn	Selection of electric thermal characteristics	0 - 7	4
Pb	Selection of Dynamic brake	0: Disabled , 1: Enabled	1 (Note 1)
Pbr	PBR value	1.0 - 1000 ohm	Depends on capacity (Note 1)
PbCP	PBR capacity	0.01 - 600 kW	Depends on capacity (Note 1)
F240	Starting frequency	0.0 - 10.0 Hz	0.0
F307	Selection of base frequency voltage	0: Without power supply voltage compensation Without output voltage limit 1: With power supply voltage compensation Without output voltage limit 2: Without power supply voltage compensation With output voltage limit 3: With power supply voltage compensation With output voltage limit	1 (Note 2)
F375	Pulse number of PG input	12 - 9999	1000
F606	OL reduction starting frequency	0.0 - 30.0 Hz	0.0

Note 1: It is necessary to set to use the braking resistor.

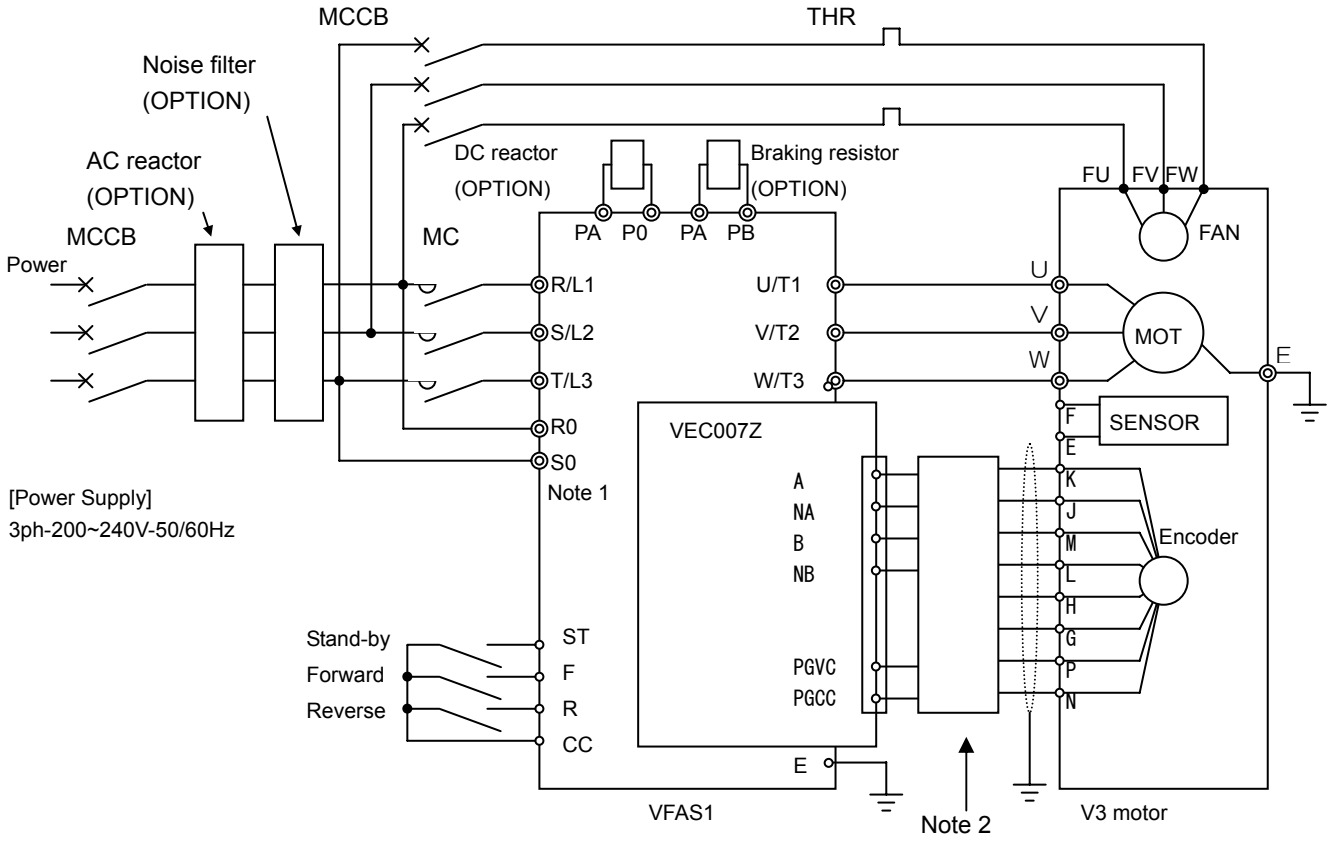
Note 2: In case of pt = 2~4, 6~8, the function of 'power supply voltage compensation' is always enabled.

[Others parameter setting]

About current/ speed control gain, please refer "E6581333: Current and speed control gain adjustment method".

2.2 Standard connection for VFAS1 and V3 motor

This connection diagram is for VFAS1 and VEC007Z(Vector control option with sensor).
When you select torque control, it is necessary to wire others connection.

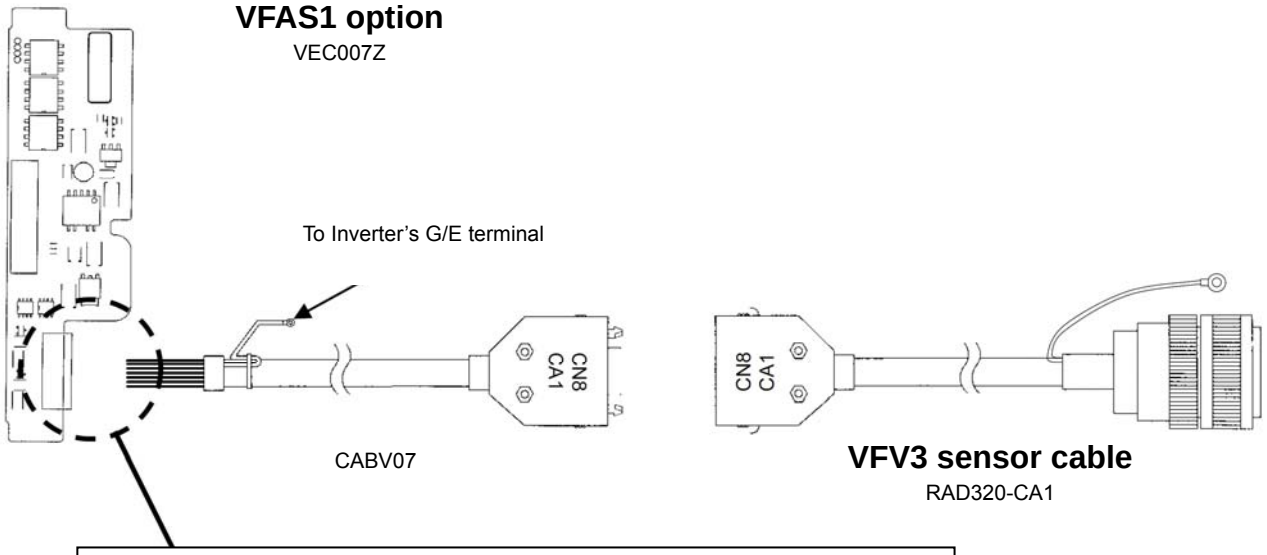


Note1 To divide the wiring between main power and control power, it is necessary to install CPS002Z(Backup unit of control power supply).

Note2 When using V3 motor cable (RAD320-CA1), please use connection relay cable (**CABV07**).
When connect the new VFV3 motor, please select **CAB011** instead of RAD320-CA1 and CABV07.

Note3 The detail explanation for VEC007Z, please refer attached user's manual for VEC007Z(E6581319).

2.3. Optional cable (CABV07)



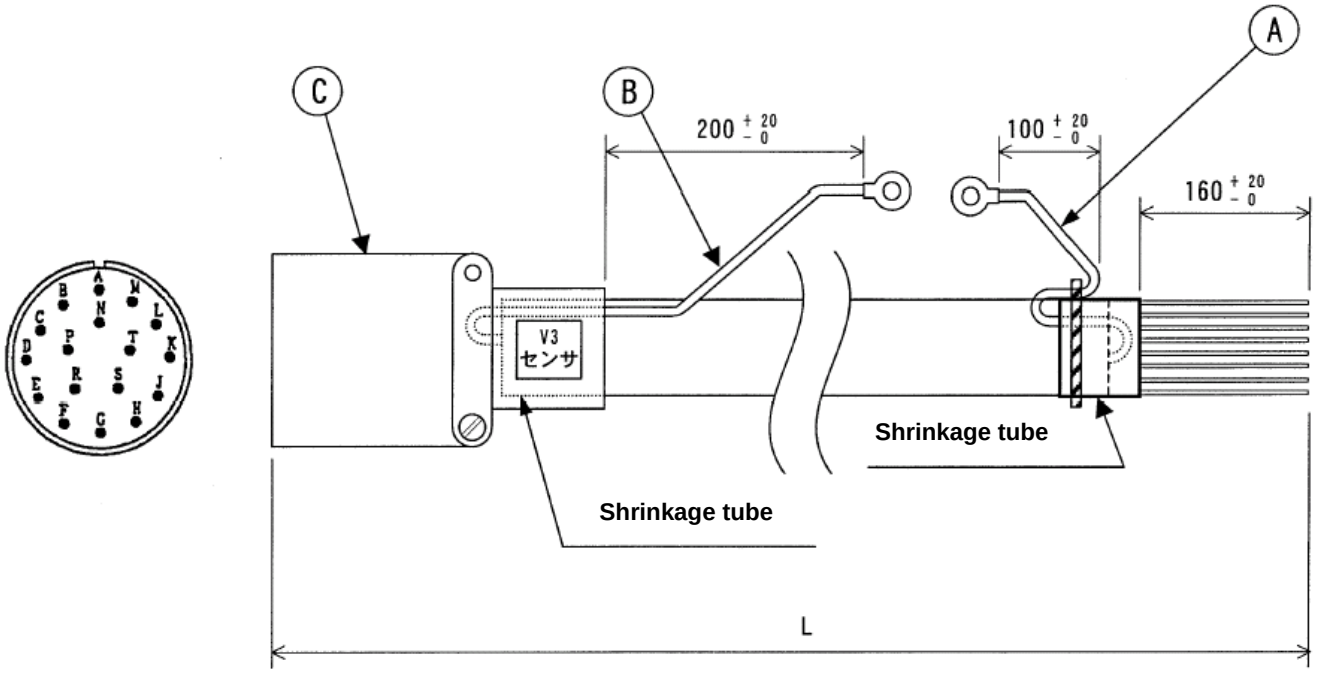
SIGNAL NUMBER	SIGNAL NAME	WIRE COLOR	
6	PGCC	Black	Red
5	PGVC	Black/White	Red/White
4	NB	Green	
3	B	Green/White	
2	NA	Yellow	
1	A	Yellow/White	

To connect each wire to terminal block.

2.4. Optional cable (CAB011)

The Optional cable ‘CAB011’ has 3 type of cable length.

Type-form	Cable length(m)
CAB011-10M	10m
CAB011-20M	20m
CAB011-30M	30m



A: Shielded cable
- Cable: UL1015 AWG18
- Color: Green/Yellow
- Amp: R1.25-5

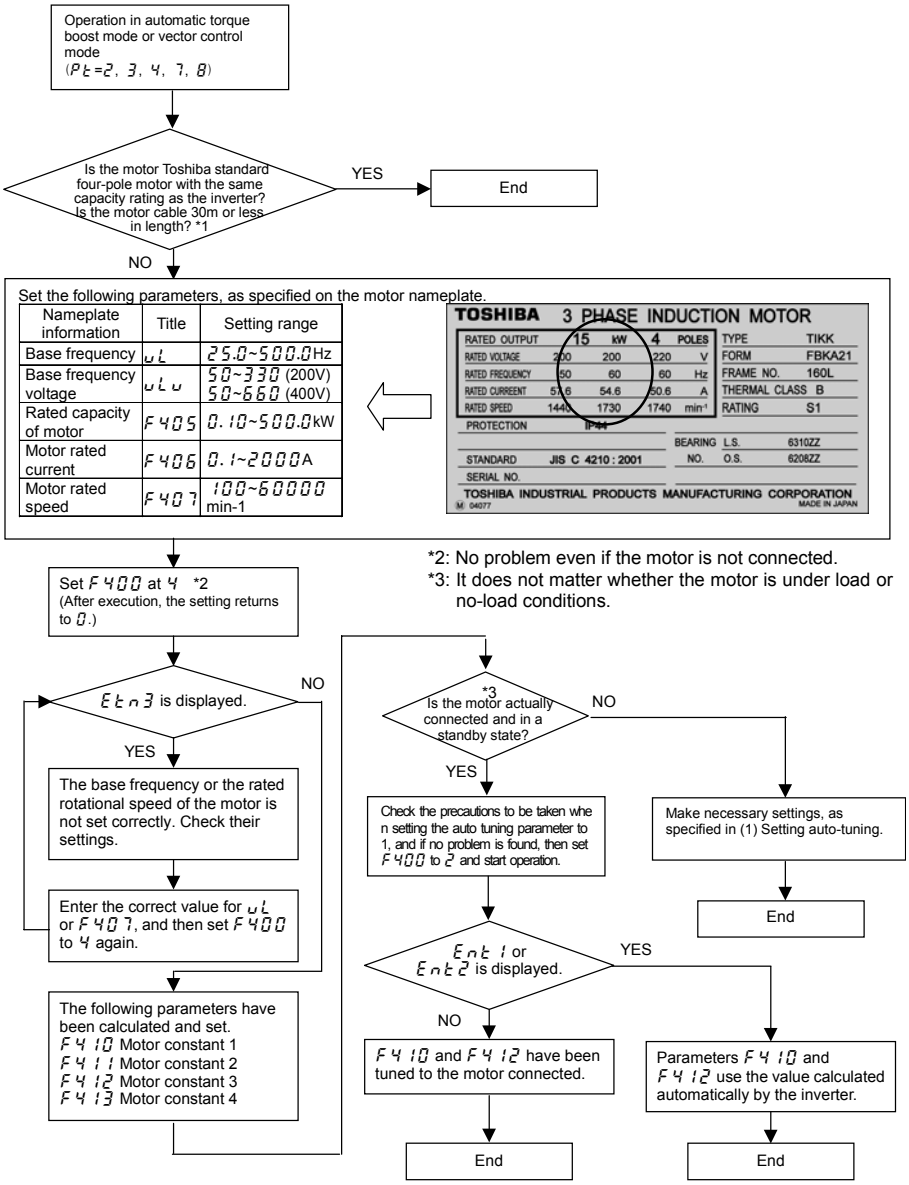
B: Shielded cable
- Cable: UL1015 AWG12
- Color: Green
- Amp: 3.5-5S

C: RA23 sensor
- Straight plug: JL02-68-20-B29SC-F0
- Contact: 031-50968-010
- Cable clump: MS3057-12A

Sensor cable:
- Cable: KVC-36SB, 0.2mm^2, 4-pair

3. Appendix

3.1 Setting the rating of the motor



*1:

Motor used			Tuning required or not (Yes in flowchart: Tuning required, No: Tuning not required)
Type	No. of motor poles	Capacity	
Toshiba standard motor	4P	Same as the inverter capacity	* Not required (tuned to factory defaults)
		Different from the inverter capacity	Required
	Other than 4P	Same as the inverter capacity	
		Different from the inverter capacity	
Others			

* When using a long cable (guide: 30m or over), be sure to make auto-tuning 1 (F400 = 2).

3.2 Explanation of motor parameter

This section describes how to set motor constants. Select the items to be improved and change the related motor constants.

(1) Slip frequency gain F401

This parameter is to adjust the slippage of the motor.

Setting this parameter at a larger number can reduce the slippage of the motor. However, setting it at an excessively large number may result in hunting, etc., and thus cause an unstable operation.

(2) Motor constant 1 F410 (Torque boost) (Motor test reports may be useful.)

This parameter is to adjust the primary resistance of the motor. Setting this parameter at a larger value can prevent the drop of the motor torque in low speed ranges due to a voltage drop. However, setting it at an excessively large number may result in large current in low speed range and appearance of an overload trip, etc.

(3) Motor constant 2 F411 (No-load current) (Motor test reports may be useful.)

This parameter is to adjust the exciting inductance of the motor. The larger the set value, the more exciting current can be increased. Note that specifying a too large value for the motor constant may cause hunting.

(4) Motor constant 3 F412 (Leak inductance) (Motor test reports may be useful.)

This parameter is to adjust the leakage inductance of the motor. The larger the set value, the larger torque the motor can produce in high-speed ranges.

(5) Motor constant 4 F413 (Rated slip)

This parameter is to adjust the secondary resistance of the motor. The amount of compensation for slip increases with increase in this value.

(6) F460 (Speed loop proportional gain)

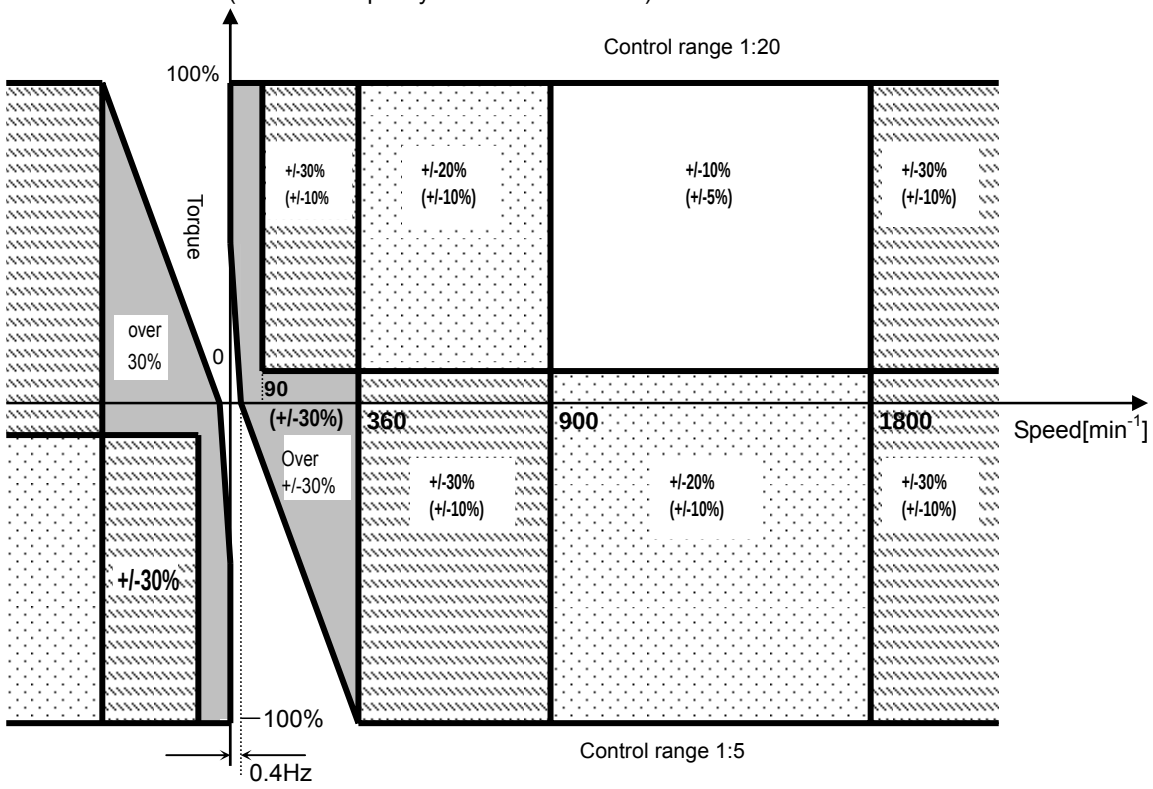
This parameter is to adjust the gain responsive to speed. Specifying a large gain increases the speed of response, but specifying an excessively large gain may result in the occurrence of hunting. If operation is unstable and hunting occurs, operation can be stabilized in most cases by reducing the gain.

(7) F462 (Moment of inertia of load)

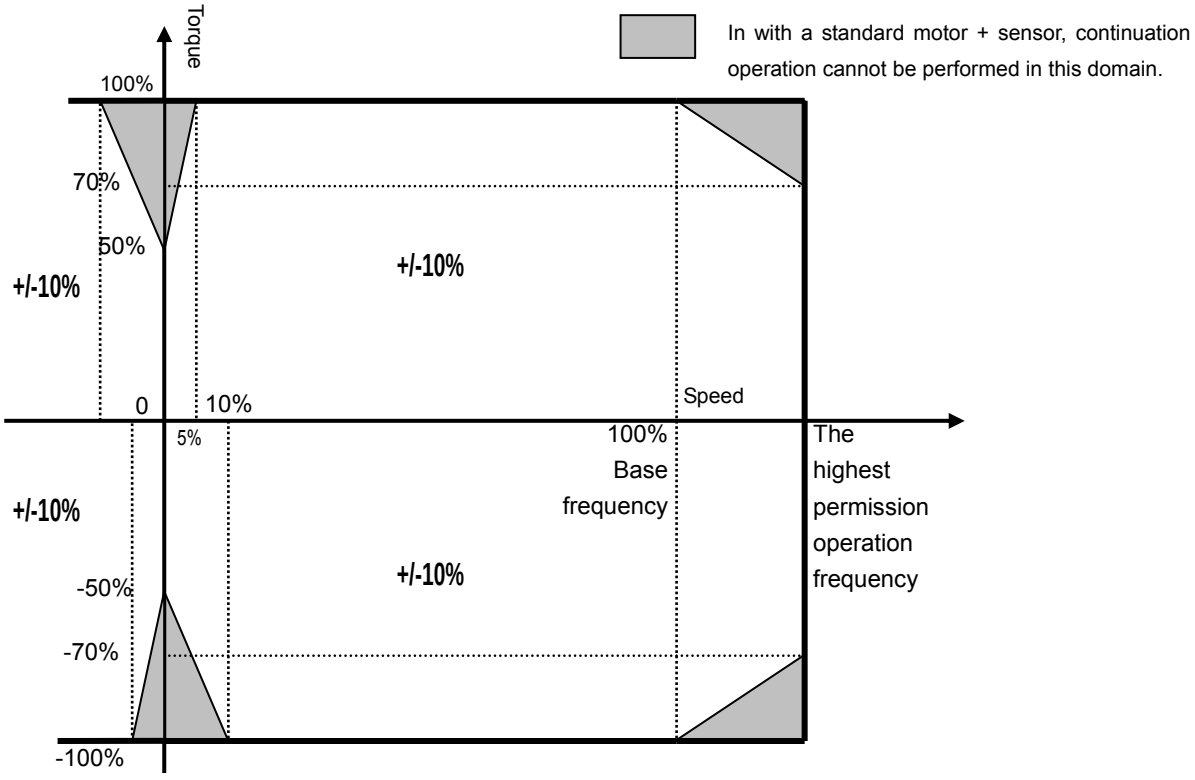
This parameter is used to adjust the excess response speed. Specifying a large value reduces the amount of overshoot at the completion of acceleration. So, specify a value appropriate to the actual moment of inertia of the load.

3.3 Accuracy of torque control

- Sensor-less vector control. (Inverter's capacity is same as motor's.)



- Vector control with sensor. (Inverter's capacity is same as motor's.)



3.4 Notes on the vector control

1) To use vector control mode (Pt = 8) with V3 motor, enter each motor constant indicated on the nameplate (uL (base frequency), uLu (base-frequency voltage), F405 (rated capacity of motor), F406 (rated current of motor) and F407 (rated number of revolutions of motor)), read the precautions on auto-tuning 1 on section 6.22 (1) in E6581442, and then set F400 to 2 (auto-tuning).

2) The sensorless vector control exerts its characteristics effectively in frequency areas below the base frequency (uL). The same characteristics will not be obtained in areas above the base frequency.

3) When driving V3 motor, it is necessary to select capacity of VFAS1 larger than V3's.
ex. 200% output torque: 1 class-up, 300% output torque: 2 class-up

4) Always operate the motor in single operation (one inverter to one motor). Sensorless vector control cannot be used when one inverter is operated with more than one motor.

5) The torque produced by the motor decreases more or less around the rated frequency because of a voltage drop cause motor-generated torque in the vicinity of rated frequency to be somewhat lower.

6) Connecting a reactor or surge voltage suppression filter between the inverter and the motor may reduce motor-generated torque. Setting auto-tuning 1 may also cause a trip (Etn, Etn 1 ~ 3)rendering sensorless vector control unusable. In the event of a trip, perform auto-tuning with the inverter connected directly to the motor, or enter the motor constant calculated from the motor test results.

7) Connect speed sensor for vector control with sensor to the motor. Connecting via gear, etc. causes motor's oscillating or inverter's trip by lack of rigidity.