TOSHIBA

E6581947

VFAS1
Motor Control instruction manual

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1. PARAMETERS FOR MOTOR CONTROL

Here after is the parameter list for VF-AS1 motor control.

AS1 motor parameter list

	parameter	function	Pt control law					Accessible during running?	For what?
			0, 1	2	3, 4	5	7, 8		
			0:V/f constant 1:Variable torque	Automatic torque boost	Sensor-less Vector control	VF5points (for power supply)	Vector control		
Basic parameter	uL [Hz]	Basic frequency 1	★	★1★2	★1★2	★	★1★2	No	V/f ratio (rotor flux)
	uLu [V]	Basic voltage 1	★	★1	★1	★	★1	No	V/f ratio (rotor flux)
	ub [%]	Torque boost 1	○8	-	-	○8	-	Yes	Stator resistance compensation
	F405 [kW]	Motor rated power	—	★1★2	★1★2	—	★1★2	No	Motor power
	F406 [A]	Motor rated current	○9	★1	★1	○9	★1	No	Motor rated current
	F407 [rpm]	Motor rated speed	○9	★1★2	★1★2	○9	★1★2	No	-Rated speed -Rotor time constant
	F410 [%]	Motor coefficient 1 (Torque boost)	—	☆3	☆3	—	☆3	Yes	Stator resistance compensation
	F411 [%]	Motor coefficient 2 (no load current)	○9	☆3	☆3	○9	☆3	No	Magnetizing current
	F412 [-]	Motor coefficient 3 (Leakage coefficient)	○9	☆3	☆3	○9	☆3	No	Leakage coefficient
	F413 [%]	motor coefficient 4 (Motor Slip)	○9	☆3	☆3	○9	☆3	No	Slip coefficient
Adjust parameter	F401 [%]	Slip frequency gain	—	—	○4	—	○4	Yes	Slip gain
	F415 [%]	Exciting strengthening coefficient	—	○5	○5	—	○5	No	Increasing flux at low speed
	F416 [%]	Stall prevention factor	○6	○6	○6	○6	○6	No	Current limit at field weakening
	F495 [%]	Max output voltage modulation rate	○7	○7	○7	○7	○7	No	Over -modulation rate
Speed loop adjust parameter	F460	Speed loop gain	—	○	○	—	○	Yes	Speed loop gain
	F461	Speed loop stabilization coefficient	—	○	○	—	○	Yes	Speed loop stabilization coefficient
	F462	Moment of Inertia	—	○	○	—	○	Yes	Speed loop filter
Current loop gain	F458 [Hz]	Current loop gain	○	○	○	○	○	No	Current loop gain

★ : the parameter to be set mandatory

☆ : the parameter to be set automatically by auto-tuning

○ : the parameter to be set if necessary

— : the parameter not to be used

★1: The parameters are set before auto-tuning, corresponding to the application motor (by motor name plate or test report).
It is necessary to set for special motor and small motor. It is also recommended to set for normal motor.
In case of p (pole pair), it is estimated by the difference between Fn and Nn, so please confirm their relation to correspond to the slip of the applied motor.
However,
Pn : Motor rated power (F405 [kW])
Fn : Base frequency (vL [Hz])
Nn : Motor rated speed (F407 [min^{-1}])
p : pole pair [-]

★2: Nominal torque(100%), that is referred to by torque limitation or torque reference and so on, is defined by
Pn*1000/(2*pai*Fn/p)

☆3: The parameter to be set automatically by auto-tuning. Please refer to the procedure of auto-tuning in Instruction Manual.

〇4: The parameter is to adjust slip compensation. It is the rate for compensation to rated slip.

〇5: The parameter is flux rate at low speed. It is for enhance output torque at low speed (first it is necessary to do auto-tuning)

〇6: In case this parameter is small, the vibration of load current is reduced at field weakening area, however, motor current is increased which cause to motor maximum torque decrease limited by load current.

〇7: It is effective in the improvement of the speed stall in field weakening region.

〇8: The parameter is used for the output torque performance at low speed.

〇9: The parameter is referred to as the typical value for the calculation of motor parameters. Normally not need to set.
It's better to set in case the values are known (by motor test report) for special motor as high speed motor and so on.

2. THE EFFECTIVE PARAMETERS FOR PT=2, 3,4,7,8

2.1 Adjustment of speed loop gain

2.1.1 Parameter setting

parameter	function	range	Default setting
F460	Speed loop gain	1～9999	12
F461	Speed loop stability coefficient	1～9999	100
F462	The filter of speed reference	0～100	35

2.1.2 parameter adjustment

Please refer to Instruction Manual E6581333 for details.

problem	countermeasure	Side effect
- Motor speed is overshoot after acceleration is finished. - Motor speed is undershoot (goes round to opposite direction) before deceleration stop	- F460 to be adjusted as F460= %J * 12 - To increase F460 every 2 times (up to 48) and to decrease F461 every half at the same time. (refer to E6581333 for details)	-
- Motor is overshoot after rapid acceleration	- To increase F461 every 100 (up to 1000)	-

2.2 Adjustment of current loop gain

2.2.1 Parameter setting

parameter	function	range	Default setting
F458	Current loop gain	1～1000	0

2.2.2 Parameter adjustment

Normally not need to set.
Please refer to Instruction Manual E6581333 for details.

problem	countermeasure	Side effect
- Vibration of the motor or noise caused by such the vibration in the area where the output frequency is around the base frequency.	- To decrease F458 from 0(*1) up to 25 (refer to E6581333 for details)	-

*1 0(default) means
100 in case of the inverters of 200V-15kW or less and 400V-18.5kW or less
50 in case of the inverters of 200V-18.5kW or more and 400V-22kW or more

2.3 F415（flux enhancement at low speed）

2.3.1 Parameter setting

parameter	function	range	Default setting
F415	Flux enhancement rate at low speed	100%～130%	100%

2.3.2 Parameter adjustment

It is necessary to set PT=2 or 3,4,7,8 to set motor parameters from motor nameplate, and to do auto-tuning when high output torque at low speed is needed.
If more output torque is needed after doing this procedure, to increase F415 is effective.
In case F415 is large, the magnetizing current at low speed is increased, therefore flux is increased and motor torque is possible to increase in the limited current.
However, even if F415 is large, motor flux is not linearly increased because of flux saturation depends on the motor characteristic.

2.4 F416(stall reduction at field weakening area)

2.4.1 Parameter setting

parameter	function	range	Default setting
F416	Stall reduction at field weakening area	10～250	100

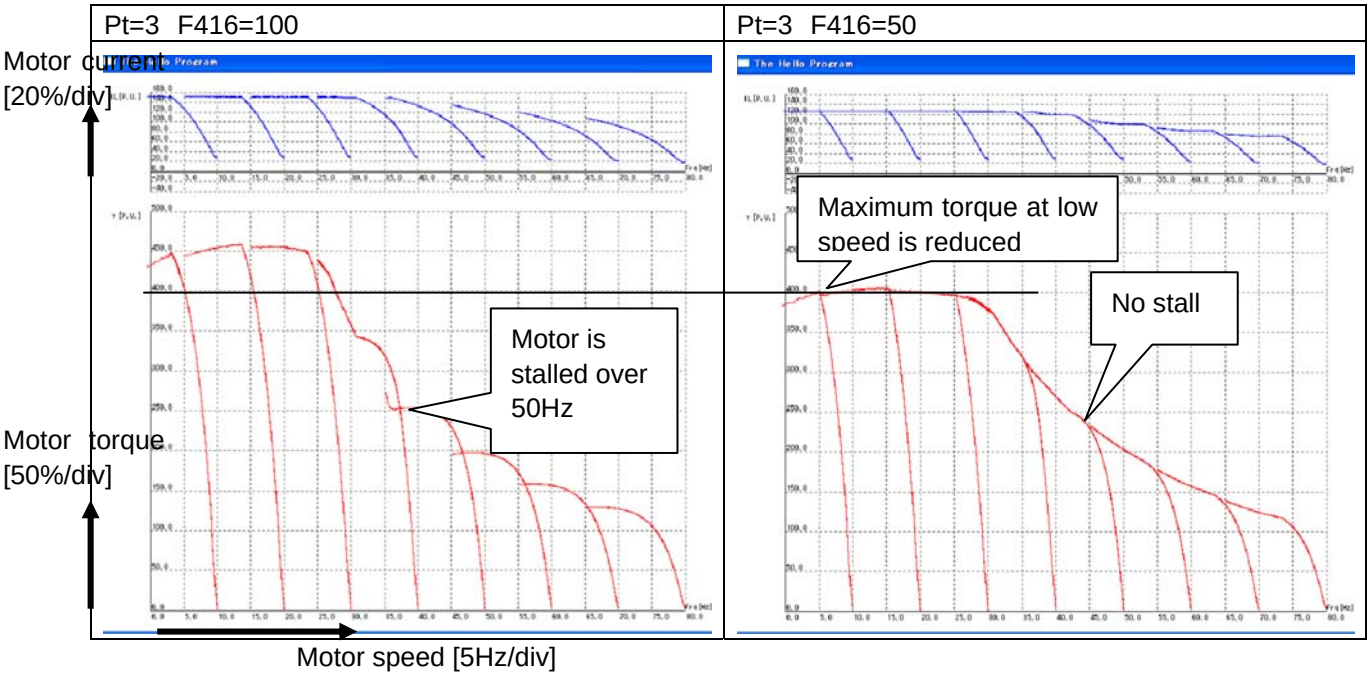
2.4.2 Parameter adjustment

In case of the driving at field weakening area, motor flux is reduced therefore motor maximum torque is also reduced. In such condition, when instant torque is obtained motor is stalled even if motor current is less than current limitation.
There are 2 conditions for field weakening area. One is over the base frequency; the other is DC bus voltage reduction. Especially single phase inverter, DC bus voltage is reduced in case of heavy load.
In such case, reduction of F416 every 5 is effective.

problem	countermeasure	Side effect
Motor is stalled in case of the driving with input voltage reduction, or at field weakening area	To reduce F416 every 5	Maximum torque at low speed is reduced

2.4.3 Example of adjustment

system: INV:AS1-2007 Motor:0.4kW-200V-60Hz
input voltage:165V



2.5 F495(over modulation / maximum voltage adjustment)

2.5.1 Parameter setting

parameter	function	range	Default setting
F495	over modulation / maximum voltage adjustment	0:Normal 1 :Straight 100% 2 : 102.5% 3 : 105%	0

2.5.2 Parameter adjustment

To increase maximum torque at nominal point, increase of F495 is effective.

problem	countermeasure	Side effect
- Out put voltage is reduced at field weakening area. - Motor current is increased at field weakening area.	To increase F495	- Motor is oscillated at field weakening area In this case, to decrease F458 from 0(*1) up to 25

3. THE EFFECTIVE PARAMETERS FOR PT=0, 1, 5

3.1 Current differential gain

3.1.1 Parameter setting

parameter	function	range	Default setting
F467	Current differential gain	0:Disabled 1:Enabled(Low gain) 2: Enabled(Middle gain) 3: Enabled(High gain)	0

3.1.2 Parameter adjustment

To improve the motor unstable, it is effective to adjust F467 even if F467=1, especially motor unstable at no load and small inertia condition.
The table below shows the tendency of phenomenon at each inertia and F467 conditions.
Generally, the possibility of motor vibration is increased in case inertia and F467 are both small.

inertia	F467	Acceleration performance	Deceleration performance	Disturbance response
small	small	Increase vibration	Increase vibration	Increase vibration
	big	Decrease vibration	Decrease vibration	Decrease vibration
big	small	Decrease speed overshoot	Current ripple is big	Fast response
	big	Increase speed overshoot	Current ripple is small	Slow response