

VFMB1

Motor Control instruction manual

(detail edition)

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This manual is deals with firmware "Ver100".
The firmware will be updated without any notice.

CONTENTS

1	PARAMETERS FOR MOTOR CONTROL.....	3
2	ADJUSTMENT OF SPEED LOOP GAIN AT PT=3,4,5.....	5
2.1	PARAMETER SETTING.....	5
2.1.1	About F459.....	5
2.1.2	About F460.....	7
2.1.3	Adjustment of F459, F460, F461.....	8
2.2	PARAMETER ADJUSTMENT	10
3	CURRENT DIFFERENTIAL GAIN FOR PT=0,1,2,7	11
3.1	PARAMETER SETTING	11
3.2	PARAMETER ADJUSTMENT	11
4	OVER VOLTAGE PREVENTION CONTROL.....	12
4.1	PARAMETER SETTING	12
4.2	VALIDATION	12
4.2.1	The relation deceleration time and stop distance (compared to nC1)	12
4.2.2	The relation the parameter F305,F307and stop distance	13
5	F480(FLUX ENHANCEMENT AT LOW SPEED)	14
5.1	PARAMETER SETTING	14
5.2	PARAMETER ADJUSTMENT	14
6	F485(STALL REDUCTION AT FIELD WEAKENING AREA)	15
6.1	PARAMETER SETTING	15
6.2	PARAMETER ADJUSTMENT	15
6.3	THE EXAMPLE OF ADJUSTMENT	15
7	F495(OVER MODULATION / MAXIMUM VOLTAGE ADJUSTMENT)	16
7.1	PARAMETER SETTING	16
7.2	PARAMETER ADJUSTMENT	16
8	POWER RIDE THROUGH	17
8.1	PARAMETER SETTING	17
7.2	PARAMETER ADJUSTMENT	17
9	SPEED SEARCH.....	18
9.1	PARAMETER SETTING	18
9.2	PARAMETER ADJUSTMENT	18
9.3	THE SEQUENCE OF SPEED SEARCH(SOFTWARE SEARCH).....	19
9.4	SPEED SEARCH DETAILED SEQUENCE RELATED TO PARAMETERS	20
10	CARRIER FREQUENCY	21
10.1	PARAMETER SETTING	21
10.2	CARRIER FREQUENCY FOR 3 PHASE MODULATION.....	21
10.3	CARRIER FREQUENCY AT SYNCHRONIZED PWM.....	22
10.4	CARRIER FREQUENCY REDUCTION.....	23
10.5	CARRIER FREQUENCY UPPER LIMITATION AT “MICRO SERGE PREVENTION”	23
11	OVER TORQUE TRIP.....	24
11.1	PARAMETER SETTING	24

11.2 DETECTION LEVEL	24
11.3 DETAILS OF DETECTION.....	24
11.4 VALIDATION	25
12 DC INJECTION.....	26
12.1 PARAMETER SETTING	26
12.2 PARAMETER ADJUSTMENT	26
13 ACCELERATION/DECELERATION OPERATION AFTER TORQUE LIMIT	27
13.1 PARAMETER SETTING	27
13.2 PARAMETER ADJUSTMENT	27

1 PARAMETERS FOR MOTOR CONTROL

Here after is the parameter list for VF-MB1 motor control.

MB1 motor parameter list

	parameter	function	P _ε control law						Accessible during running ?	For what ?
			0	1.7	2	3	4.5	8		
			V/f constant	Variable torque VF5points	Automatic torque boost	Vector control	(dynamic) Energy saving	VF5points (for power supply)		
Basic parameter	ω_L [Hz]	Basic frequency 1	★	★	★	★	★	★	Yes	V/f ratio (rotor flux)
	$\omega_L U$ [V]	Basic voltage 1	★	★	★	★	★	★	Yes	V/f ratio (rotor flux)
	F405 [kW]	Motor rated power	—	—	★1	★1	★1	—	No	Motor power
	F412 [%]	motor coefficient 1	○2	○2	○3	○3	○3	—	No	Leakage coefficient
	F415 [A]	Motor rated current	○	○	★1	★1	★1	—	No	Motor rated current
	F416 [%]	Motor no load current	○1	○1	○1	○1	○1	—	No	Magnetizing current
	F417 [rpm]	Motor rated speed	☆2	☆2	★2	★2	★2	—	No	-Rated speed -Rotor time constant
	ω_b [%]	Torque boost 1	☆3	☆3	—	—	—	—	Yes	Stator resistance compensation
	F402 [%]	Automatic torque boost	—	—	☆	☆	☆	—	Yes	Stator resistance compensation
Adjust parameter	F401 [%]	Slip gain	—	—	—	☆4	—	—	Yes	Slip gain
	F480 [%]	motor coefficient 7	—	—	☆5	☆5	☆5	—	No	Increasing flux at low speed
	F485 [%]	motor coefficient 8	○4	○4	○4	○4	○4	—	No	Current limit at field weakening
	F495 [%]	motor coefficient 9	○5	○5	○5	○5	○5	—	No	Over-modulation rate
Speed loop adjust parameter	F459	Load inertia	—	—	—	☆6	☆6	—	Yes	Load inertia
	F460 [Hz]	Motor special constant 3	—	—	—	☆6	☆6	—	Yes	Speed loop gain
	F461	Motor special constant 4	—	—	—	☆6	☆6	—	Yes	Speed loop dumping coefficient
	F462	Motor special constant 5	—	—	—	○	○	—	Yes	Speed loop filter
	F467	Motor special constant 6	○	○	○	—	—	—	Yes	Current differential gain
	F654 [Hz]	Current differential time constant (inverse)	○	○	○	—	—	—	No	Current differential time constant (inverse) (Hz)

Current loop gain	F458[Hz]	Current loop gain	○	○	○	○	○	—	No	Current loop gain
	Fb49	Current loop dumping coefficient	○	○	○	○	○	—	No	Current loop dumping coefficient

*1 depends on the setting of “Set up menu”. Please refer to the instruction manual 11.5.

*2 depends on product range. Please refer to the instruction manual 11.4.

- ★ : 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 needed for the motor current of auto-tuning.

* it is necessary to set for special motor and small motor. It is also recommended to set for normal motor.

★2: The parameters is used for “rated slip” and “rotor time constant”.

If V/f ratio is changed from nominal state, rated speed is needed to change as below.

$$N_{r_new} = F_{n_new} * 60 / P - U_n / F_n * (F_n * 60 / P - N_r) * F_{n_new} / U_{n_new}$$

☆3: The parameter is used for the output torque performance at low speed.

☆4: The parameter is to adjust slip compensation.

It is the rate for compensation to rated slip.

☆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)

☆6: The speed loop gain is automatically adjusted by F459(load inertia) in case F460=0(default setting).

○1: The parameter is used for the calculation of “rotor time constant”. Normally not need to set.

It is better to set in case the value is known (by motor test report).

○2: The parameter is used for the calculation of “stator time constant”. Normally not need to set.

It effects dynamic performance of V/f control ramp stop .

○3: The parameter is used for the calculation of output voltage and “stator time constant”.

○4: It is necessary to set it for the improvement of speed stall at field weakening area.

○5: In case this parameter is small, current vibration is reduced at field weakening area, however, motor current is increased which cause to motor maximum torque decrease.

2 ADJUSTMENT OF SPEED LOOP GAIN AT PT=3,4,5

2.1 Parameter setting

parameter	function	range	Default setting
F459	Load inertia (rate to rotor inertia)	0.1~100	1
F460	Speed loop gain	0~25	0
F461	Speed loop stability coefficient	0.5~2.5	1.0
F462	The filter of speed reference	0~100	35

Here after is the detail explanation of F459, and F460 which is different from AS1 .

2.1.1 About F459

F459 means the load inertia . it is the rate to the rotor inertia of Toshiba standard motor.
 In case rotor inertia and total (load + rotor) inertia are both known, F459 can be calculated by the following equation.

$$J_{Total} = K_J \cdot J_{m0}$$

$$J_c = \frac{\left(\frac{J_{m0}}{p^2} \cdot \frac{1}{InMot} \right)}{\left(\frac{J_0}{p_0^2} \cdot \frac{1}{InMot_0} \right)}$$

$$F459 = K_J \cdot J_c$$

K_J :load inertia rate to the rotor inertia

J_{m0} :rotor inertia of target motor

p :pole pair of target motor

$InMot$:rated current of target motor

J_c :compensation coefficient

J_0 :rotor inertia of Toshiba standard motor

$InMot_0$:rated current of Toshiba standard motor

The table below shows the inertia of Toshiba standard 4 pole motors which is used as the base inertia of F459.

The data of 2 pole and 6 pole motors are reference data.

note) 0.2 to 0.75kW are steel framed motor, 1.5 to 3.7kW are aluminium die-cast framed motor.

■full closing type

power (kW)	2 pole		4 pole		6 pole	
	Frame size	inertia	Frame size	inertia	Frame size	inertia
0.2	63M	0.00037	63M	0.00079	71M	0.0011
0.4	71M	0.00057	71M	0.0012	80M	0.0031
0.75	80M	0.0011	80M	0.0027	90L	0.0043
1.5	90L	0.0015	90L	0.004	100L	0.0067
2.2	100L	0.0021	100L	0.006	112M	0.0105
3.7	112M	0.0038	112M	0.0078	132S	0.0265

White cell: steel framed motor

Orange cell: aluminium die-cast framed motor

Even if Toshiba motor, inertia is possibly different in case the frame is different.

In such case, F459 setting is needed.

The table below is F459 setting in case of no load (motor only).

The value of F459 setting in case of no load (motor only)

		Motor 2Pole(kW)					
		0.2	0.4	0.75	1.5	2.2	3.7
Inverter (kW)	0.2	2.15					
	0.4	2.41	2.06				
	0.75	1.81	1.55	1.63			
	1.5		1.95	2.05	1.55		
	2.2			1.95	1.48	1.46	
	3.7				1.87	1.85	2.03
		Motor 4Pole(kW)					
		0.2	0.4	0.75	1.5	2.2	3.7
Inverter (kW)	0.2	1.00					
	0.4	1.12	1.00				
	0.75	0.85	0.75	1.00			
	1.5		0.95	1.26	1.00		
	2.2			1.20	0.95	1.00	
	3.7				1.20	1.26	1.00
		Motor 6Pole(kW)					
		0.2	0.4	0.75	1.5	2.2	3.7
Inverter (kW)	0.2						
	0.4		1.05				
	0.75		0.79	0.64			
	1.5		0.99	0.81	0.64		
	2.2			0.77	0.61	0.70	
	3.7				0.77	0.89	1.41

In case the rate of load inertia and motor inertia is known, F459 can be set with the table above.
 For example, Inverter is nC3-2037, motor is 2.2kW 2-pole Toshiba standard motor (aluminium frame) ,
 Load inertia(with motor) is 3 times of motor inertia,
 The recommended value of F459 is $K_j * J_c = 1.85 * 3 = 5.6$

2.1.2 About F460

F460 means speed loop gain (Hz).

In case F460=0(default setting), the gain is automatically calculated (it is described below in detail).

In case F460 is not 0, gain is equal to F460.

The speed loop gain has a limitation which is "150/F459". For example, in case F459=100, the upper limitation of speed loop gain is $150/100=1.5\text{Hz}$ even if F460 is higher than 1.5Hz.

Automatic adjustment of speed loop gain (F460=0)

The speed loop gain is calculated by 2kinds of inputs.

One is speed ramp rate, and other is load inertia.

The gain from speed ramp rate is

$$F0_ramp = \text{MAX}(3\text{Hz}, 0.0255 * FH / \text{Min}(\text{ACC}, \text{DEC}))$$

The gain from load inertia is

$$F0_inertia = 30 * (\text{InDefMotor} / \text{InMotor}) / F459$$

(InDefMotor: rated current of same sized motor, InMotor: rated motor current)

Final result of the gain is smaller one of both, furthermore it is limited between 1Hz to 10Hz.

$$F0_out = \text{MIN}(10\text{Hz}, \text{MAX}(1\text{Hz}, \text{MIN}(F0_ramp, F0_inertia)))$$

For example,

Inverter: nC3-2022 , Motor: 4P 2.2kW , FH=80 ACC=DEC=0.5

A: total inertia (F459) is 5.0

$$F0_ramp = \text{MAX}(3\text{Hz}, 0.0255 * 80 / 0.5) = 4\text{Hz}$$

$$F0_inertia = 30 / 5 = 6\text{Hz}$$

$$F0_out = \text{MIN}(10\text{Hz}, \text{MAX}(1\text{Hz}, \text{MIN}(F0_ramp, F0_inertia))) = 4\text{Hz}$$

A: total inertia (F459) is 10.0

$$F0_ramp = \text{MAX}(3\text{Hz}, 0.0255 * 80 / 0.5) = 4\text{Hz}$$

$$F0_inertia = 30 / 10 = 3\text{Hz}$$

$$F0_out = \text{MIN}(10\text{Hz}, \text{MAX}(1\text{Hz}, \text{MIN}(F0_ramp, F0_inertia))) = 3\text{Hz}$$

2.1.3 Adjustment of F459, F460, F461

The figures below show the motor speed at each value of the parameter.

The figure 1 shows the motor speed trend at each F459 in case the total inertia is 6 times of motor inertia. In case F459 is smaller than 6.0, motor speed is overshoot. On the contrary, F459 is bigger than 6.0, motor speed is little bit delayed to be stabilized.

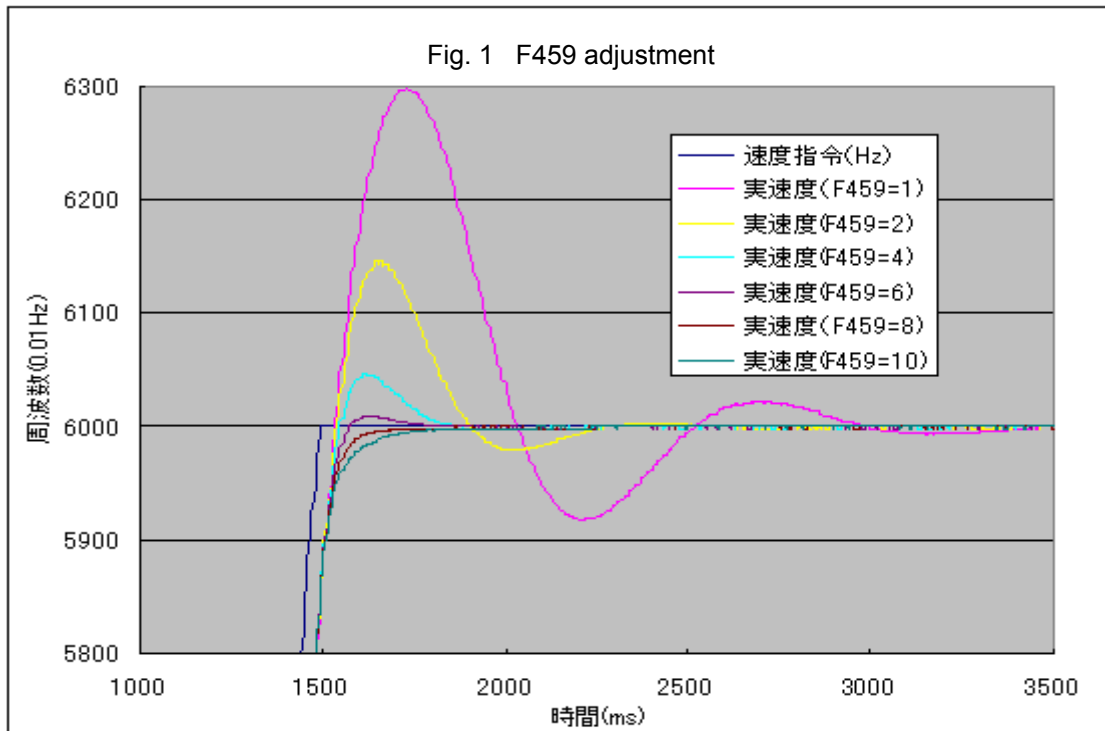


Figure 2 shows the motor speed trend at each F460 in case ACC=0.4sec. In case F460 is 0, F460 is automatically calculated to 5.0, motor speed is well tracked to speed reference. In case F460 is small, motor speed is delayed to speed reference.

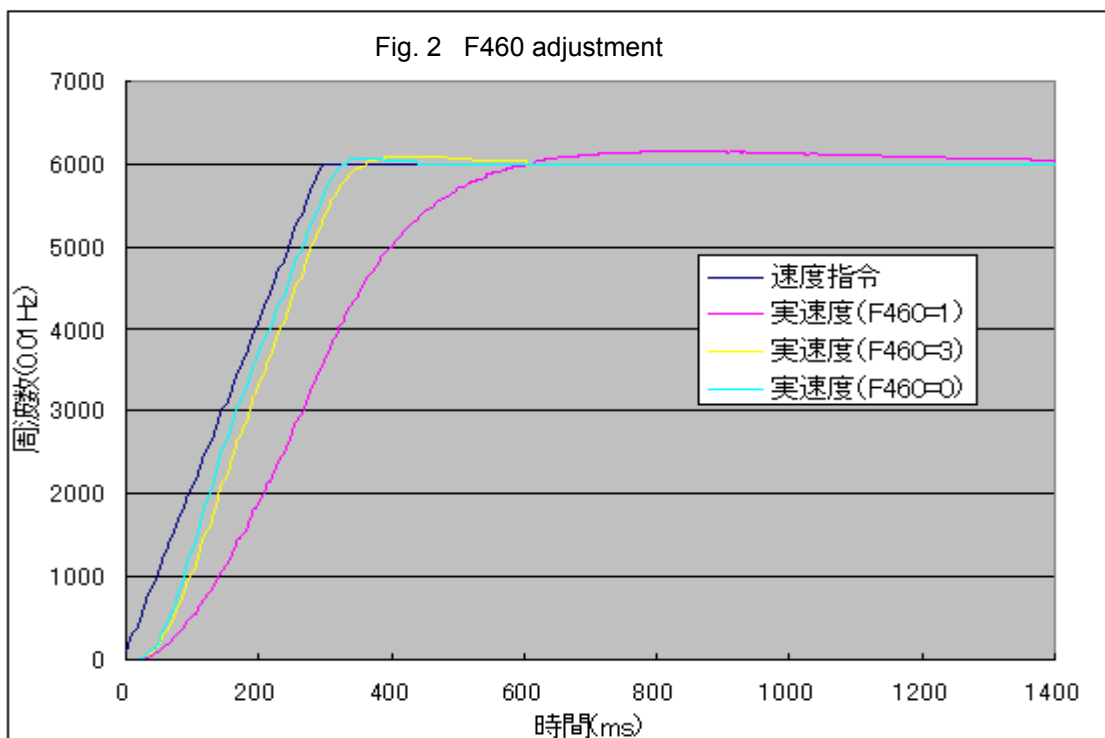
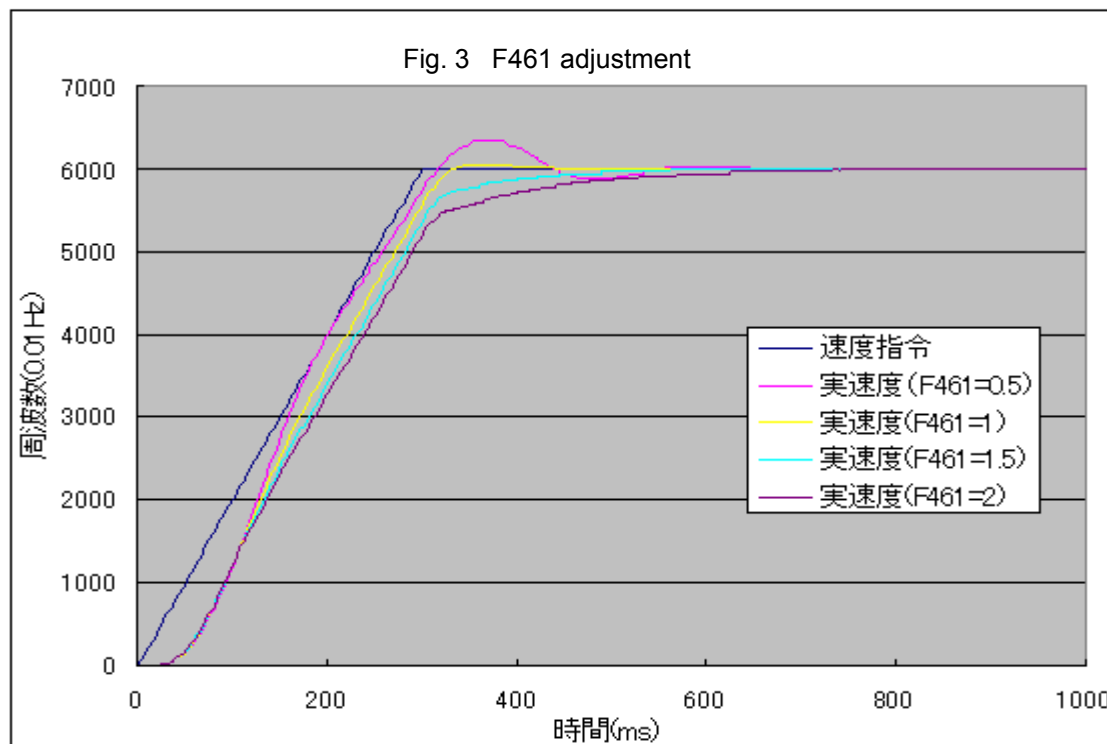


Figure 3 shows the motor speed trend at each F461. In case F461 is less than 1.0, motor speed is overshoot. On the contrary, in case F461 is bigger than 1.0, motor speed is delayed to be stabilized.



Normally, the adjustment of speed loop gain is only set the F459.

In case of PT=4, the speed loop gain is the half value of PT=3 under the same condition .

2.2 parameter adjustment

problem	countermeasure	Side effect
How to adjust F459 ?	- In case total inertia is known, F459 can be calculated from the equation on the section 2.1.1	-
	- In case total inertia is unknown, it is helpful to take speed response as the figure 1 on section 2.1.3. In case overshoot appears, F459 must be increase.	-
- Motor speed is overshoot after acceleration is finished. - Motor speed is undershoot (goes round to opposite direction) before deceleration stop	-To adjust F459 (factory setting is 1.0) to the total inertia.	-
- Adjustment of disturbance response at acceleration	- To increase F461 every 0.1 (up to 1.30)	- In case F461 is big, the speed stabilization is delayed.
- Adjustment of disturbance response at constant speed	-To adjust F459 -To increase F460 (factory setting is 0.0) up to 10.0 .	-In case F460 is big, the speed is overshoot.
- Motor is overshoot after rapid acceleration	- To increase F461 every 0.1 (up to 1.30)	-
- E-13 trip occurs at torque disturbance or load is off at field weakening area	-To adjust F459 -To increase F460 (factory setting is 0.0) up to 10.0 . -To increase F461(factory setting is 1.00) every 0.1 up to 1.30. -To increase FH every 10Hz in case FH and speed command are same. (it is in the case the problem still occurs even if these adjustment above are already done)	- In case F461 is big, the speed stabilization is delayed. -In case F460 is big, the speed is overshoot.

3 CURRENT DIFFERENTIAL GAIN FOR PT=0,1,2,7

3.1 parameter setting

parameter	function	range	Default setting
F467	Current differential gain	0~100	10

3.2 parameter adjustment

To improve the motor unstable , it is effective to adjust F467, 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

4 OVER VOLTAGE PREVENTION CONTROL

4.1 parameter setting

parameter	function	range	Default setting
F305	Over voltage prevention selection	0: enabled 1: disabled 2: enabled (rapid deceleration) 3: enabled (dynamic rapid deceleration)	2

4.2 validation

Here after is the result of the “stop distance(the distance from stop command is operated to finally stopped)” .

4.2.1 The relation deceleration time and stop distance (compared to nC1)

Deceleration characteristics

VFNC3-2022P								
FC=60Hz	F305=0		F305=1		F305=2 (Default)		F305=3	
	enable		disable		enable quick deceleration		enable dynamic quick deceleration	
DEC [s]	Pt=0	Pt=3	Pt=0	Pt=3	Pt=0	Pt=3	Pt=0	Pt=3
1.0	same as F305=1		11915	13011	same as F305=1		same as F305=1	
0.5	6544	7277	6150	6951	6313	7058	6176	6955
0.4	-	-	5008	5622	-	-	-	-
0.3	-	-	OP2	OP2	-	-	-	-
0.1	5773	6219	OP2	OP2	4880	5091	3711	4102

VFNC1-2022P <FC=60Hz>						
FC=60Hz	F305=0 (Default)		F305=1		F305=2	
	enable		disable		enable quick deceleration	
DEC [s]	Pt=0	Pt=3	Pt=0	Pt=3	Pt=0	Pt=3
1.0	same as F305=1		12774	12534	same as F305=1	
0.5	same as F305=1		7364	7186	same as F305=1	
0.1	5822	5725	5431	5396	5900	5681

VFNC3-2022P								
FC=80Hz	F305=0		F305=1		F305=2 (Default)		F305=3	
	enable		disable		enable quick deceleration		enable dynamic quick deceleration	
DEC [s]	Pt=0	Pt=3	Pt=0	Pt=3	Pt=0	Pt=3	Pt=0	Pt=3
1.0	same as F305=1		20925	22465	same as F305=1		same as F305=1	
0.8	-	-	16831	18330	-	-	-	-
0.7	-	-	OP2	OP2	-	-	-	-
0.5	16840	18334	OP2	OP2	13587	14114	10731	11886
0.1	16303	16732	OP2	OP2	11453	11637	8525	9469

VFNC1-2022P						
FC=80Hz	F305=0 (Default)		F305=1		F305=2	
	enable		disable		enable quick deceleration	
DEC [s]	Pt=0	Pt=3	Pt=0	Pt=3	Pt=0	Pt=3
1.0	same as F305=1		21580	21609	same as F305=1	
0.8	-	-	17533	17483	-	-
0.7	-	-	15635	15582	-	-
0.6	-	-	OP2	OP2	-	-
0.5	15187	15084	OP2	OP2	15027	14719
0.1	12522	12695	OP2	OP2	12265	12262

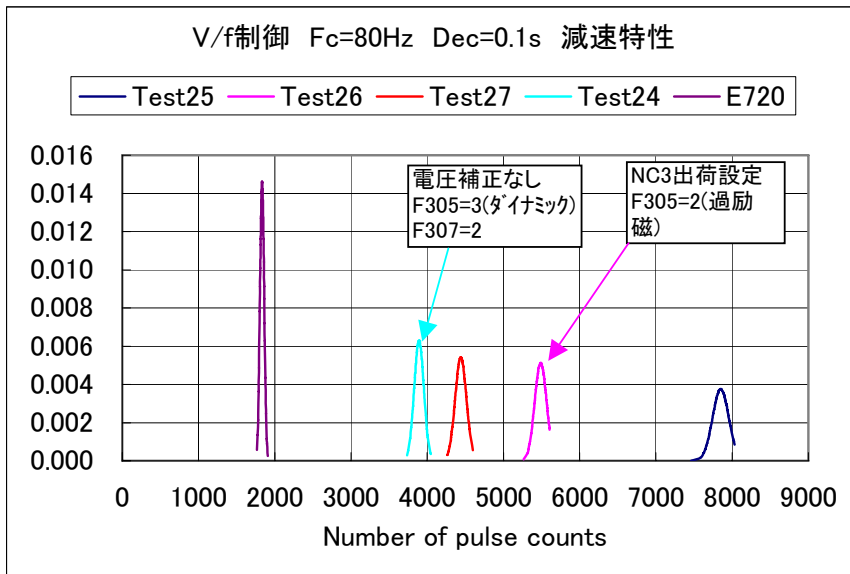
4.2.2 The relation the parameter F305,F307and stop distance

Here after is the test result comparing several combination of F305 and F307 an nC3.

Test condition: PT=0, Fc=80Hz, DEC=0.1s

In case F307=3, stop distance depends on F305.

In case F307=2, stop distance is independent of F305.



Test No	F305	F307
25	0	
26	2(def)	3
27	3	def
24	3	2

5 F480 (FLUX ENHANCEMENT AT LOW SPEED)

5.1 parameter setting

parameter	function	range	Default setting
F480	Flux enhancement rate at low speed	100%~150%	120%

5.2 parameter adjustment

It is necessary to set PT=2 or 3, 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 F480 is effective.

In case F480 is large, the magnetizing current at low speed is increased, therefore flux is increased and motor torque is possible to increase.

The increase of magnetizing current is only at the increase of torque current, therefore motor current is not increased at no load condition.

However, even if F480 is large, motor flux is not linearly increased because of flux saturation.

6 F485(STALL REDUCTION AT FIELD WEAKENING AREA)

6.1 parameter setting

parameter	function	range	Default setting
F485	Stall reduction at field weakening area	10~250	100

6.2 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.

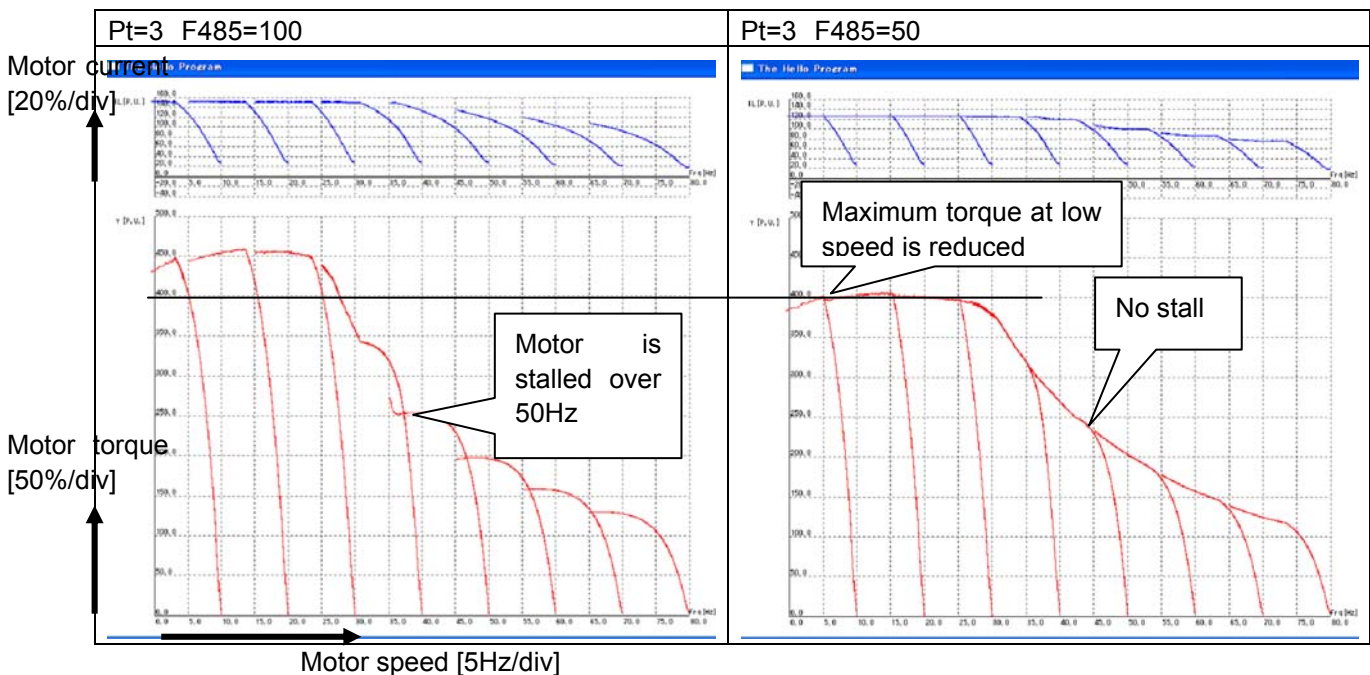
There are 2 conditions for field weakening area. One is over the base frequency, the other is DC bus voltage reduction. Especially single phase inverter, DC bus voltage is reduced in case of heavy load.

In such case, reduction of F485 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 F485 every 5	Maximum torque at low speed is reduced

6.3 the example of adjustment

system: INV:nC3-2007 Motor:0.4kW-200V-60Hz
input voltage: 165V



7 F495(OVER MODULATION / MAXIMUM VOLTAGE ADJUSTMENT)

7.1 parameter setting

parameter	function	range	Default setting
F495	over modulation / maximum voltage adjustment	90~110	104

7.2 parameter adjustment

To increase maximum torque at nominal point, the default value of F495 is 104% which is little bit “over modulation”. But, in over modulation area, output voltage is not complete sinusoidal, therefore the possibility of current oscillation is increased.

To reduce F495 is effective for

problem	countermeasure	Side effect
Motor is oscillated at field weakening area	To reduce F495 to 100, ->95, -> 90	- Out put voltage is reduced at field weakening area. - Motor current is increased at field weakening area.

8 POWER RIDE THROUGH

8.1 parameter setting

parameter	function	range	Default setting
F302	Power ride through selection	0: disabled 1: bus maintain 2: ramp stop	0
F310	Deceleration time for "ramp stop"	0.0 – 320.0	0.0

Bus maintain(F302=1) : The function which makes driving continue using the regenerative energy from the motor, when the power failure occurs.

Ramp stop(F302=2) : The function which makes driving stop using the regenerative energy from the motor, when the power failure occurs.

8.2 parameter adjustment

In case motor vibration or OP trip occurs during power ride through, these parameters below could be adjusted.

parameter	function	range	Default setting
F412	Leakage inductance	0~20	5
FB54	Inverse of current differential filter time constant(Hz)	1~250	20

problem	countermeasure	Side effect
- OP trip occurs during "ramp stop"	- To adjust F310	-
- OP trip occurs during "ramp stop" - Motor is vibrating and MOFF occurs during "bus-maintain" (for PT=0,1,2)	- To set F412=10.0 - To decrease FB54 every 5 (in case FB54 is reduced, F467(current differential gain) must not to be decreased.)	- motor current is oscillated at field weakening area in case of rapid deceleration

9 SPEED SEARCH

9.1 parameter setting

LED display	Com. number	function	Unit convert	unit LED / com	range	Default
<i>Fb81</i>	FB81	Motor configuration bits	-	1/ 1	0-FFFFh	4000h
<i>F415</i>	0415	Motor rated current	A	0.01/0.01	0.10-50.00	*1
<i>F491</i>	0491	Ramp rate for speed search	%	1/1	0-200	*1

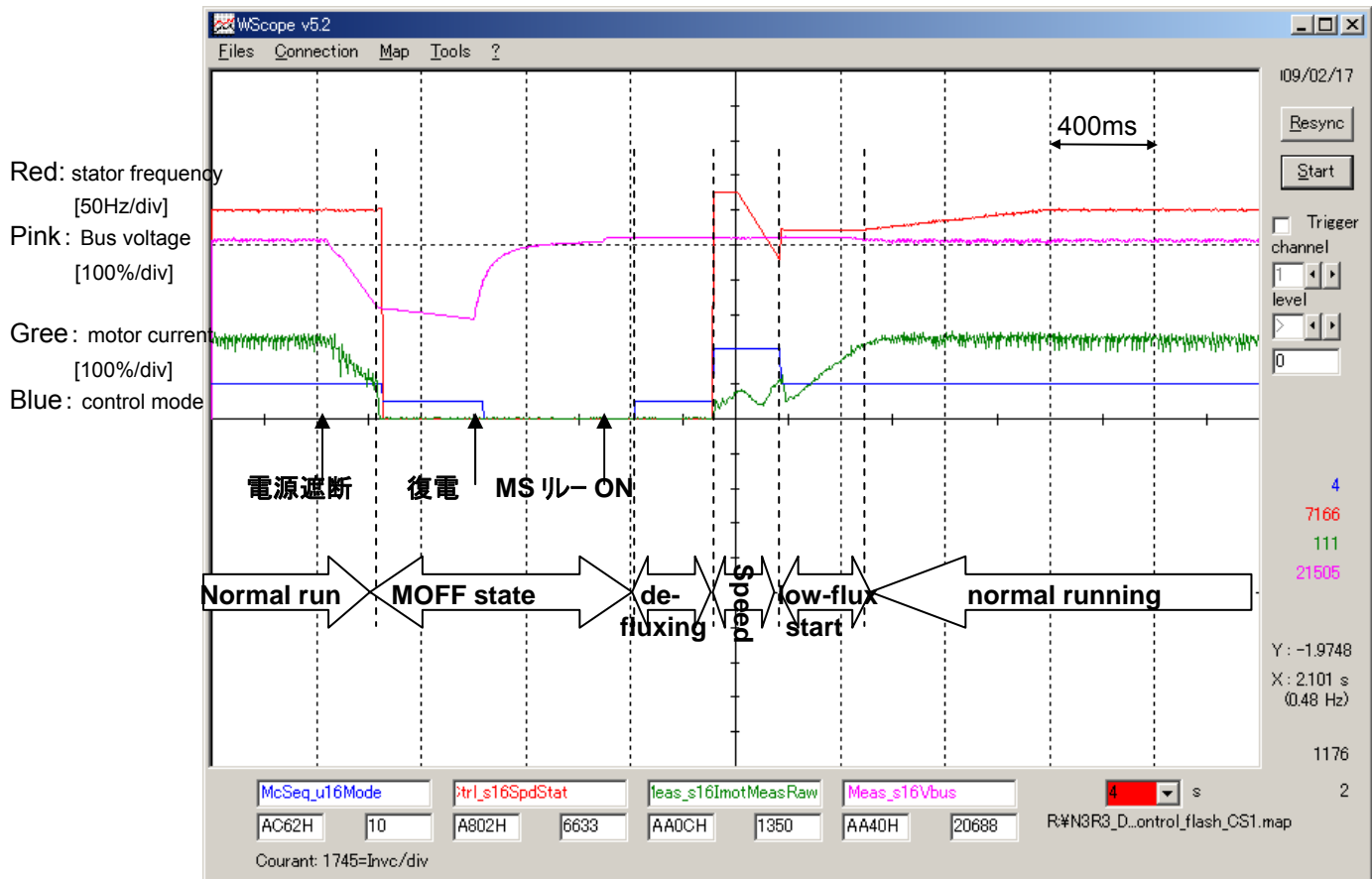
*1 default value is different at each range

9.2 parameter adjustment

There are 2 type of speed search which are “hardware speed search” and “software speed search”. In VF-MB1, it is used “hardware speed search” which does not need the parameter adjustment. To switch “software speed search”, it is necessary to set FB81=4000h, and power on reset. Here after is the trouble shooting for “software speed search”.

problem	countermeasure	Side effect
- Motor speed can not be detected and start to 0Hz.	- To reduce F491 every 5	- In case F491 is small, the possibility of motor rotation during speed search is increased.
- Motor is little bit rotated during catch on fly	- To increase F491 every 5	- In case F491 is large, the possibility to detect 0Hz is increased.
- Motor speed can not be detected only at speed upper limit(UL)	- To set F415(motor rated current) correctly	- In case F415 is small, , the possibility to detect 0Hz is increased.

9.3 The sequence of speed search (software search)



De-fluxing: - wait 300ms just after MS relay is ON

- in case gate block time is less than "FB71+300ms", wait until the total waiting time is "FB71+300ms"

Speed search: Initial voltage is that frequency is "FH+5Hz", flux is 1/7 of rated flux

The ACC/DEC time is (0.5*100/F491)sec).

The frequency is reduced from "FH+5Hz" to 0Hz to "-FH-5Hz", and torque current is detected during frequency transition. The point that the polarity of torque current is changed, it is estimated as "motor speed".

Low-flux start:

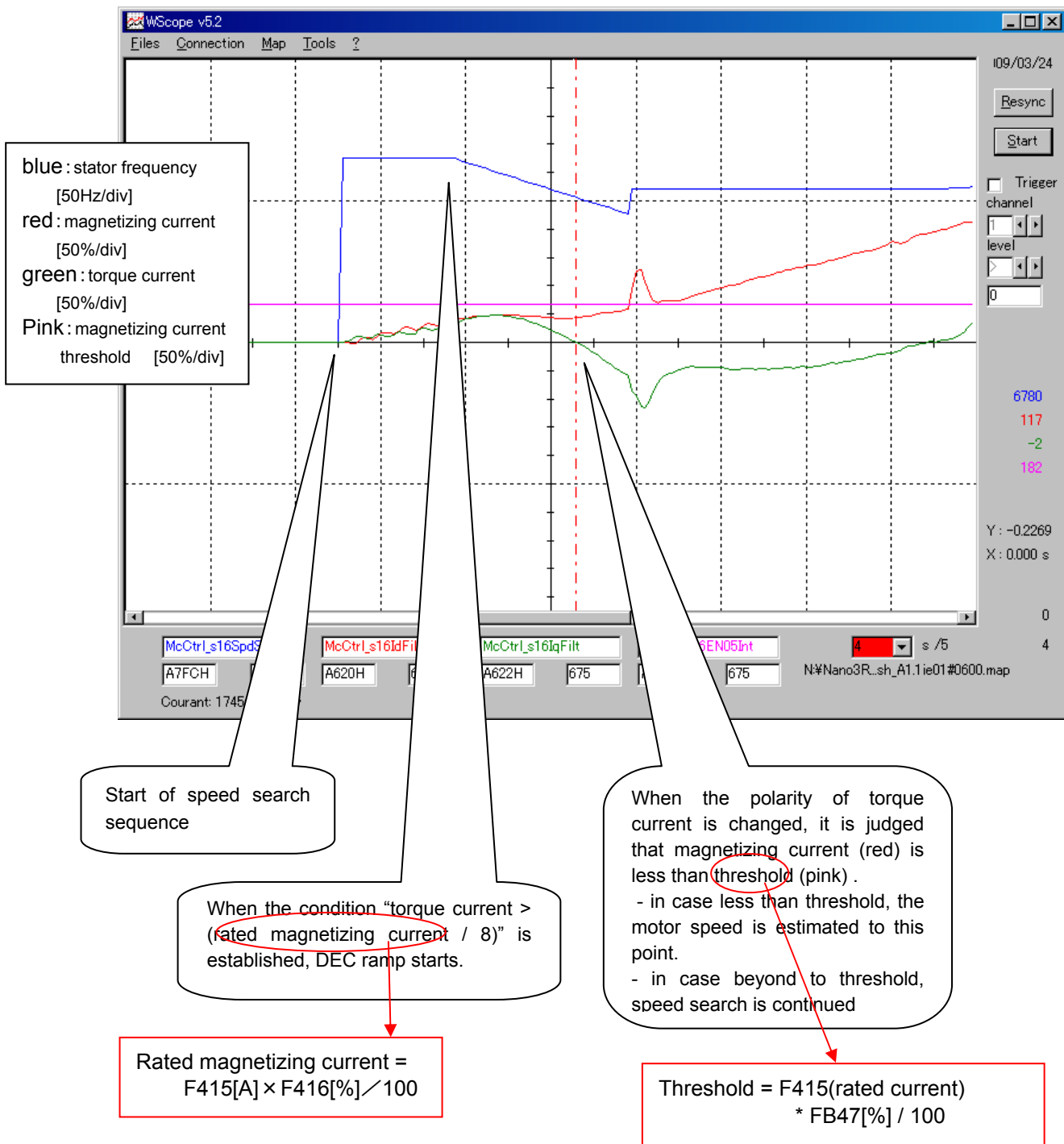
(PT=0,1,2,7)

- The motor is driven at "estimated speed" for the time "FB71*1.5"
- The flux is increased during the drive from 1/4 of rated flux to rated flux

(PT=3,4)

- The motor is driven at "estimated speed" for the time "FB71"
- The flux is increased during the drive from 1/2 of rated flux to rated flux

9.4 Speed search detailed sequence related to parameters



* The ramp for speed search is fast, the point that the polarity of torque current is changed is different from that of magnetizing current is minimum. (the point that magnetizing current is minimum comes first. At the point the polarity of torque current is changed, magnetizing current is increased, therefore it is beyond to threshold. It is one of the speed search failure.)
 To avoid this situation, it is necessary to adjust F491.

10 CARRIER FREQUENCY

10.1 parameter setting

LED display	Com. number	function	Unit convert	unit LED / com	range	Default
<i>F 3 0 0</i>	0300	Carrier frequency	kHz	1/1	2-12	4
<i>F 3 1 2</i>	0312	Random PWM	—	1/1	0 : disabled 1 : enabled	0
<i>F 3 1 6</i>	0316	Carrier reduction	—	1/1	0 : - disabled reduction - disabled micro serge prevention 1 : - enabled reduction - disabled micro serge prevention 2 : - disabled reduction - enabled micro serge prevention 3 : - enabled reduction - enabled micro serge prevention	3

10.2 carrier frequency for 3 phase modulation

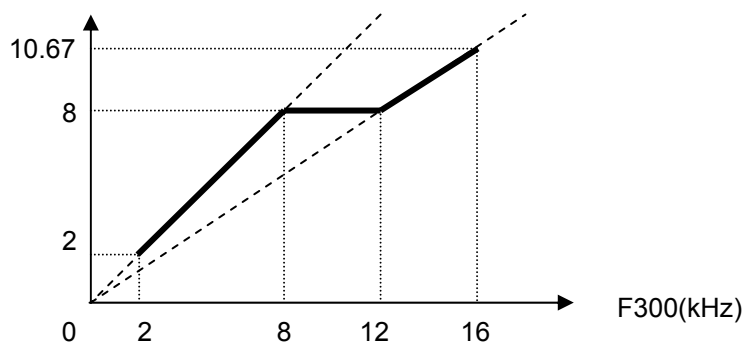
- 2 phase / 3 phase modulation change point

3 phase -> 2phase modulation change point : modulation rate = 55%

2 phase -> 3phase modulation change point : modulation rate = 45%

- carrier frequency for 3 phase modulation

Carrier frequency for 3 phase modulation (kHz)



10.3 carrier frequency at synchronized PWM

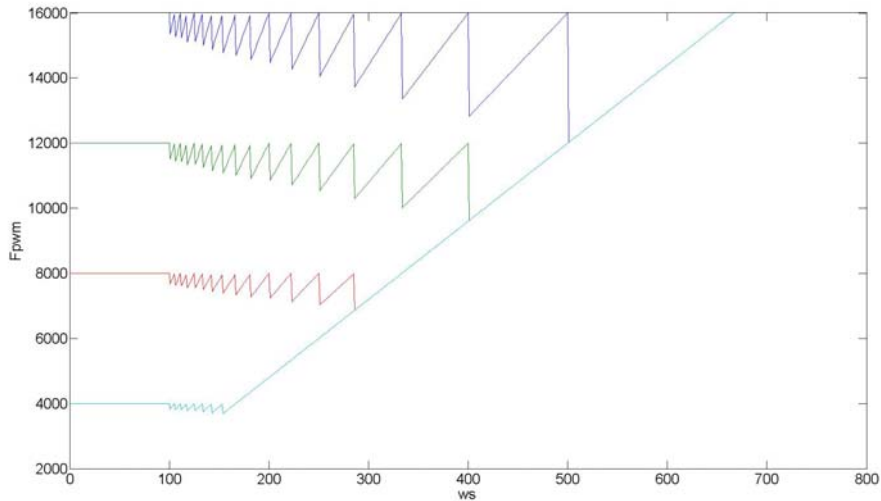
Start frequency of synchronized PWM : 105Hz

End frequency of synchronized PWM : 95Hz

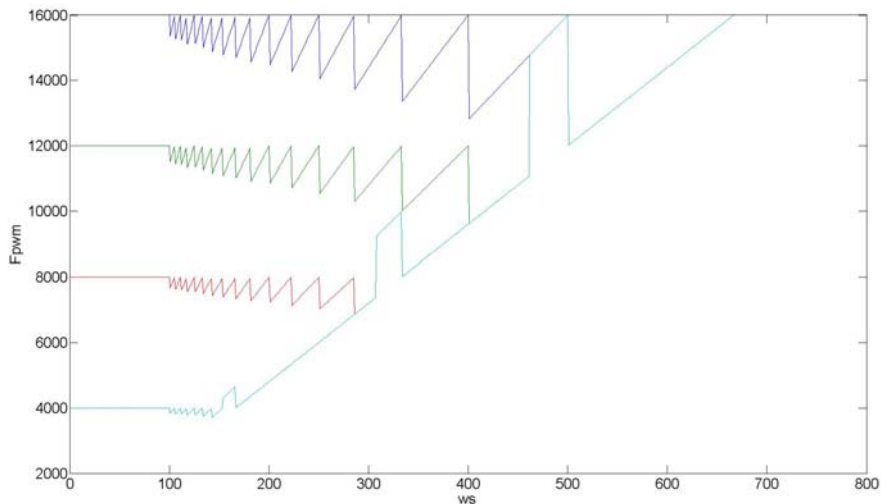
The relation between carrier frequency and stator frequency at synchronized PWM

- synchronized PWM means that carrier frequency depends on stator frequency that these relation is “carrier frequency = n * stator frequency (n is integer)”.
- In case stator frequency is beyond to “start frequency”, synchronous PWM is enabled.
- In case stator frequency is less than “end frequency”, synchronous PWM is disabled.
- In case “stator frequency * 24” is beyond to upper limit of carrier frequency, carrier frequency transits as “carrier frequency = stator frequency * 23, 22, 21... “
- In case “stator frequency * 12” is beyond to upper limit of carrier frequency, carrier frequency transits as “carrier frequency = stator frequency * 12“

In case stator frequency is increased



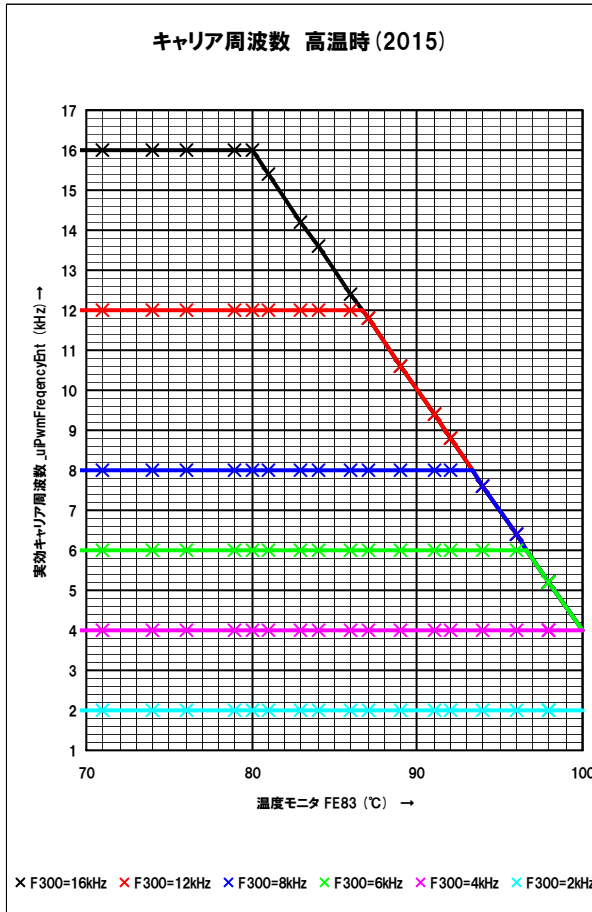
In case stator frequency is decreased



10.4 carrier frequency reduction

In case F316=1, carrier frequency is reduced under the condition below.

- The temperature of inverter heat sink is beyond 80 degree C (depend on carrier frequency as below).



- The estimated temperature rising is beyond to 45 degree C for inverter IGBT. Carrier frequency is reduced the estimation is lower than 45 degree C

10.5 carrier frequency upper limitation at “micro serge prevention”

In case F316=2,3, carrier frequency is limited to 4kHz .
 If F300 is set to the value beyond to 4kHz, carrier frequency is internally limited to 4kHz, and “A-30” alarm is displayed on LED .

11 OVER TORQUE TRIP

11.1 parameter setting

LED display	function	Unit / selection	note
F615	Over torque trip / alarm selection	0 : alarm 1 : trip	Output TB 28,29 OT blink display
F616	Over torque detection level	0.01%	0 means disabled the function
F618	Over torque detection time	0.1s	0 means fastest(4ms) detection
F619	Hysteresis of over torque detection level	0.01%	

11.2 detection level

- over torque trip(alarm) level = F616
- over torque trip(alarm) recover level = F616 – F619

11.3 details of detection

The time that motor torque (12ms filtered) is beyond to “over torque trip(alarm) level” is cumulated. The cumulated time is beyond to “over torque detection time (F618)”, over torque trip or alarm is output. Alarm is output in case F615=0, “OT” trip is output in case F615=1. In case that motor torque (12ms filtered) is less than “over torque trip(alarm) recover level” , the cumulated time is reset .

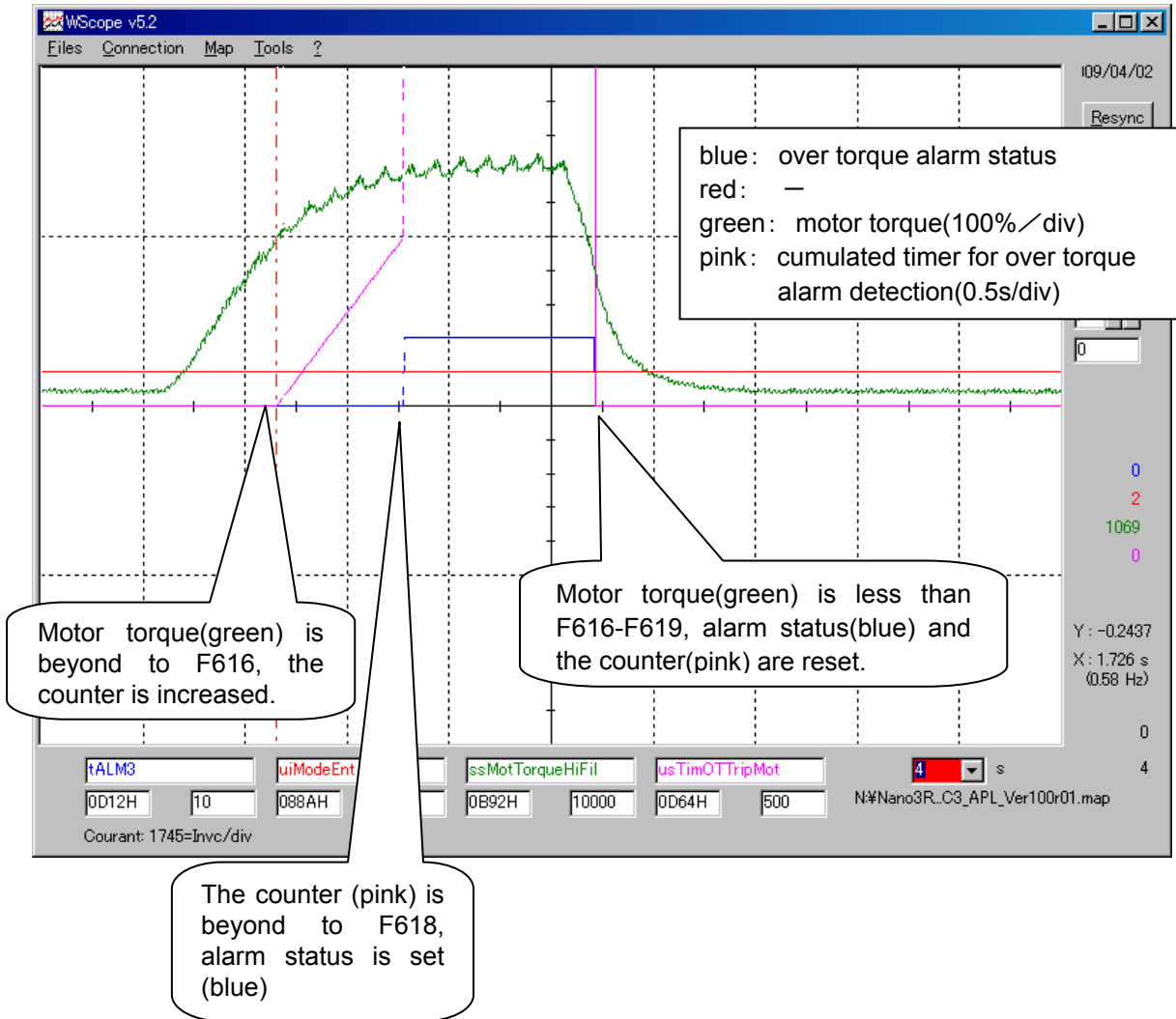
The definition of rated torque

The rated torque[N.m] means “motor power[W] * 9.55 / motor synchronized speed[rpm]”.
 For example, in case the motor rate is 4pole-60Hz-3.7kW,
 Rated torque = $3700 * 9.55 / \{60 * 120 / 4\} = 19.63$ [N.m]

11.4 validation

Parameter setting: F615=0(alarm), F616=100%, F618=0.5s, F619=20%

The figure below shows the over torque alarm state at “no load -> 150% load -> no load” during 50Hz running.



12 DC INJECTION

12.1 parameter setting

LED display	Com. number	function	Unit convert	unit LED / com	range	Default
f250	0250	Motor control bits	Hz	0.1 / 0.01	0.0-FH	0.0
f467	0467	Current differential gain	-	1 / 1	0-100	10

12.2 parameter adjustment

problem	countermeasure	Side effect
- motor is little bit rotated to opposite direction	- To increase F250 every 0.5Hz up to rated slip frequency (in case F250 is small) - To reduce F467 every 5 (in case PT=0,1,2)	- The possibility that motor is little bit rotated to forward direction is increased. - refer to the section 3.3

In case the stator frequency just before DC injection is started is negative (opposite direction), it is kept during "reducing remaining voltage" the primary part of DC injection . It causes the problem.

13 ACCELERATION/DECELERATION OPERATION AFTER TORQUE LIMIT

13.1 parameter setting

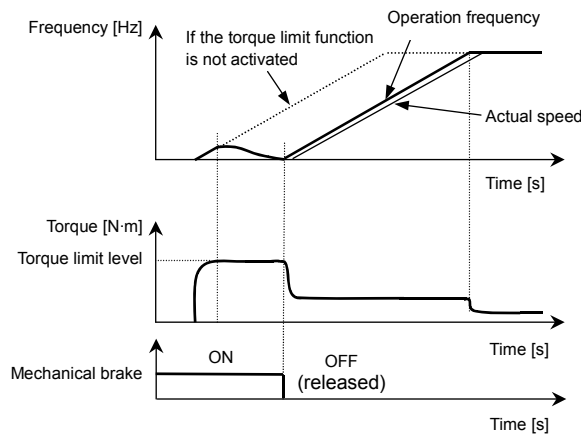
LED display	Com. number	function	Unit convert	unit LED / com	range	Default
F451	0451	Motor control bits	—	1 / 1	0-1	0

13.2 parameter adjustment

problem	countermeasure	Side effect
- After recovery from current (torque) limitation state, speed is not rapidly recovered. (want to recover the speed as fast as possible)	- To set F451 to 1.	- During OP stall, frequency monitor goes down to “start-up frequency”, even if motor speed is still high. - During OC stall, frequency monitor is not decreased even if motor speed is low.

(1) F451=0 (In sync with acceleration/deceleration)

The increase in operation frequency is inhibited by the activation of the torque limit function. In this control mode, therefore, the actual speed is always kept in sync with the operation frequency. The operation frequency restarts to increase when torque decreases as a result of the release of the mechanical brake, so the time required for the specified speed to be reached is the sum of the delay in operation of the mechanical brake and the acceleration time.



(2) F45 I= I(In sync with min. time)

The operation frequency keeps increasing, even if the torque limit function is activated. In this control mode, the actual speed is kept in sync with the operation frequency, while torque is held at a limit level when it decreases as a result of the release of the mechanical brake. The use of this function prevents the load from failing and improves the motor's response during inching operation.

