VFD-C2000 PM Motor Operation Method

1. Selection of PG Card

   The C2000 series AC motor drives support PG-01U series of PG Card for PM motors. The PG-01U series PG Card can be used with the servo motor with less wiring type of encoder (FSW1=D) or the servo motor with UVW/ABZ output encoder (FSE1=S).

2. Selection of Servo Motor

   Make sure the motor is correctly installed, properly connects the UVW phases with the power cables red, white and black.

3. C2000 Operation Steps

   1. If it is the first time for AC motor drive to drive the PM motor and there is no complete information of the PM motor (eg. Ld, Lq), please execute PM motor parameter auto-tuning (Pr.05-00=5) first.

   2. Input information into motor parameters:

Parameters	Explanation	
05-33	Induction Motor and Permanent Magnet Motor Selection	
05-34	Full-load current of Permanent Magnet Motor (A)	
05-35	Rated Power of Permanent Magnet Motor (kw)	
05-36	Rated speed of Permanent Magnet Motor (rpm)	
05-37	Pole number of Permanent Magnet Motor	
05-38	Inertia of Permanent Magnet Motor (E^{-4} kg-m^2)	
05-39	Stator Resistance of PM Motor (Ω)	
05-40	Permanent Magnet Motor Ld (mH)	
05-41	Permanent Magnet Motor Lq (mH)	
05-42	Offset angle of PM Motor pole (degree)	Measures the magnetic pole offset angle.
05-43	Ke parameter of PM Motor (mV/rpm)	
01-00	Max. Operation Frequency (Hz)	Change max. speed to max. frequency.

10-00	Encoder Type Selection	
10-01	Encoder Pulse (PPR)	
10-02	Encoder Input Type Setting	

3. If it is the first time for AC motor drive to drive the PM motor, please execute auto-tuning (Pr.05-00=4) of motor before operation begins and repeat this process every time when different PM motor is applied. When auto-tuning process is complete, the measurements will automatically write into Pr. 05-42. (Before the servo motor is delivered to the user, it is tested with auto-tuning process and the angle of magnetic poles could reach a nearly 360 degree or 0 degree.

4. If motor trial runs in VF mode, it is crucial to adjust the VF curve to prevent the occurrences of over voltage and excitation. When Pm motor starts running, make sure the motor is operate in the right direction and use the monitor page to screen motor's actual speed. In FWD command, the actual speed is positive and in REV command, the actual speed is negative. If actual speed is not consistent with operation command, change the encoder parameter Pr.10-02 to 2 (if originally set to 1) or Pr.10-02 to 1 (if originally set to 2).

5. Set Pr.00-11= 4 (PM FOCPG mode). When completed, begins trial run in low frequency.

For example:

VFD037C23A + EMC-PG01U + ECMA-E31315

Software version of control board(Pr.00-06): 1.00

DATE code(Pr.00-50): 11081

1. When running a PM motor for the first time, input following information into the parameters to begin Auto-tuning:

Parameters	Explanations	ECMA-C30604	ECMA-E31315
05-33	Induction Motor and Permanent Magnet Motor Selection	1	1
05-34	Full-load current of Permanent Magnet Motor (A)	2.6A	24.9A
05-35	Rated Power of Permanent Magnet Motor (kw)	0.4kw	1.5kw
05-36	Rated speed of Permanent Magnet	3000	2000rpm

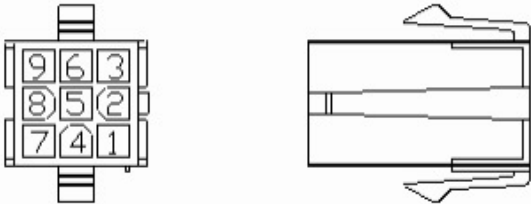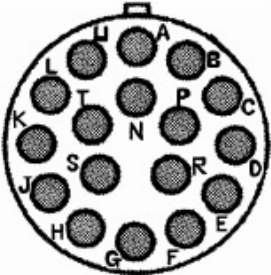|		Motor (rpm)		
05-37	Pole number of Permanent Magnet Motor	10	10
05-38	Inertia of Permanent Magnet Motor (E^{-4} kg-m^2)	0.3	11.18
05-39	Stator Resistance of PM Motor (Ω)	1.55	0.26
05-40	Permanent Magnet Motor Ld (mH)	6.71	4.01
05-41	Permanent Magnet Motor Lq (mH)	6.71	4.01
05-43	Ke parameter of PM Motor (mV/rpm)	17	31
01-00	Max. Operation Frequency (Hz)	5000	3000
10-00	Encoder Type Selection	2	2
10-01	Encoder Pulse (PPR)	2500	2500
10-02	Encoder Input Type Setting	1	1

Pr.10-00 Encoder mode:

    0: Disable

    1: ABZ pulse Encoder

    2: Delta ABZ/UVW pulse Encoder

    3: Resolver

    4: Standard ABZ/UVW pulse Encoder

2. Set Pr.05-00=4 to begin auto-tuning for the magnetic poles. Please restart the drive before each time of executing auto-tuning for magnetic poles.

3. When using Delta PM motor, please check if Pr.05-42 is close to 360 degree or 0 degree.

4. After auto-tuning is complete and magnetic pole is measured, begin trial run in VF mode first to ensure motor is running in a right speed.

Parameters	Explanations	
01-02	Max. Output Voltage Setting of Motor 1	110.0V
01-03	Mid-point Frequency 1 of Motor 1	0.00Hz
01-04	Mid-point Voltage 1 of Motor 1	0.0V
01-05	Mid-point Frequency 2 of Motor 1	0.00Hz
01-06	Mid-point Voltage 2 of Motor 1	0.0V

5. Set Pr.00-11=4 and re-apply power.

6. Set Pr.11-00=1, adjust Per Unit of System Inertia (Pr.11-01) and speed bandwidth (Pr.11-03, 11-04 and 11-05; maximum 100Hz).
7. When trial run in light load or no load, the detected output current should be lower than 1Amp.

Encoder Wiring Diagram of Delta Servo Motor

| Motor Model Name	Encoder Connector	Terminal Identification
ECMA-C30401□S (100W) ECMA-C30602□S (200W) ECMA-C30604□S (400W) ECMA-C30804□7 (400W) ECMA-C30807□S (750W)	[9 6 3 / 8 5 2 / 7 4 1] HOUSING: AMP (1-172161-9)	A
ECMA-G31303□S (300W) ECMA-E31305□S (500W) ECMA-G31306□S (600W) ECMA-G31309□S (900W) ECMA-C31010□S (1000W) ECMA-E31310□S (1000W) ECMA-E31315□S (1500W) ECMA-C31020□S (2000W) ECMA-E31320□S (2000W) ECMA-E31820□S (2000W)	3106A-20-29S	B

Terminal Identification AMP (1-172161-9)	A (Black)	/A (Black /Red)	B (White)	/B (White /Red)	Z (Orange)	/Z (Orange /Red)	+5V (Brown & Brown/White)	GND (Blue & Blue/White)	BRAID SHELD
A	1	4	2	5	3	6	7	8	9
Terminal Identification 3106A-20-29S	A (Blue)	/A (Blue /Black)	B (Green)	/B (Green /Black)	Z (Yellow)	/Z (Yellow /Black)	+5V (Red & Red /White)	GND (Black & Black /White)	BRAID SHELD
B	A	B	C	D	F	G	S	R	L

Delta's ECMA series motors are included with a 2500ppr encoder (A/B/Z/U/V/W phases). To set up the encoder, turns power ON and send U/V/W phases signal to the drive within 500msec then switch to A/B/Z signal.

When signal is send to the AC motor drive, 2500ppr A/B signal will become 10000ppr.
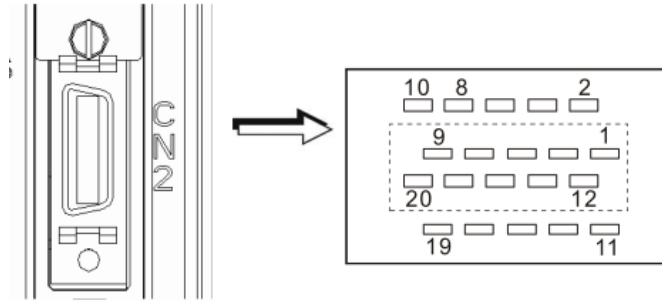
PIN No.	Signal Name	Terminal Identification	Military Connector	Quick Connector	Description
2	/Z phase input	/Z	G	6	Encoder /Z phase output
4	/A phase input	/A	B	2	Encoder /A phase output
5	A phase input	A	A	1	Encoder A phase output
7	B phase input	B	C	3	Encoder B phase output
9	/B phase input	/B	D	4	Encoder /B phase output
10	Z phase input	Z	F	5	Encoder Z phase output
14, 16	Encoder power	+5V	S	7	Encoder 5V power
13, 15	Encoder power	GND	R	8	Grounding
	Shielding	Shielding	L	9	Shielding
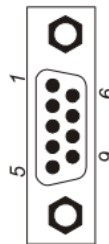
The layout of CN2 Drive Connector

CN2 Terminal Signal Identification

Pin No	Signal Name	Terminal Identification	Description	Military Connector	Fast Connector	Wire Color
4	A phase input	A	Encoder A phase output	A	A1	Black
5	/A phase input	/A	Encoder /A phase output	B	A4	Black / Red
3	B phase input	B	Encoder B phase output	C	A2	White
2	/B phase input	/B	Encoder /B phase output	D	A5	White / Red
9	Z phase input	Z	Encoder Z phase output	F	A3	Orange
1	/Z phase input	/Z	Encoder /Z phase output	G	A6	Orange / Red
8	Encoder power	+5V	Encoder 5V power	S	A7	Brown & Brown / White
6, 7	Encoder power	GND	Grounding	R	A8	Blue & Blue / White
	Shielding	Shielding	Shielding	L	A9	Shielding

VFD110C23A + PHASE Ultract3 U1007F.15.3 + EMC-PG01R

Software version of control board: 9.004

Software version of EMC-PG01U:

1. When running a PM motor for the first time, inputs following information into the parameters to begin Auto-tuning:

Parameters	Explanations	U1007F.15.3
05-33	Induction Motor and Permanent Magnet Motor Selection	1
05-34	Full-load current of Permanent Magnet Motor (A)	23.9A
05-35	Rated Power of Permanent Magnet Motor (kw)	11.6kw
05-36	Rated speed of Permanent Magnet Motor (rpm)	1500rpm
05-37	Pole number of Permanent Magnet Motor	8
05-38	Inertia of Permanent Magnet Motor (E^{-4} kg-m^2)	11.18
05-39	Stator Resistance of PM Motor (Ω)	0.33
05-40	Permanent Magnet Motor Ld (mH)	5.7
05-41	Permanent Magnet Motor Lq (mH)	5.7
05-43	Ke parameter of PM Motor (mV/rpm)	1.1
01-00	Max. Operation Frequency (Hz)	1950
10-00	Encoder Type Selection	3
10-01	Encoder Pulse (PPR)	1024
10-02	Encoder Input Type Setting	2

Pr.10-00 Encoder Type Selection：

    0: Disable

    1: ABZ pulse Encoder

    2: Delta ABZ/UVW pulse Encoder

    3: Resolver

    4: Standard ABZ/UVW pulse Encoder