



# Product Solutions Announcement

Delta Industrial Automation Global Solution Center



Product	AMD	Type	VFD-C2000	Security Level	<input checked="" type="checkbox"/> General <input type="checkbox"/> High <input type="checkbox"/> Top
				No.	N/A
Issued by	SC	Author	Andy Lin	Release Date	25th May, 2012

## C2000 drive IM with TQC sensorless

### Devices and tools:

Inverter: VFD007C43A, 1PCS (Firmware V9.019 D12201)

IM motor: 3-Phase, 380V, 0.75kW, 1PCS (Induction motor-TECO)

### Operation Steps:

1. Set 00-02=9(50Hz) or 10(60Hz) to go back factory setting.
2. Set the following parameters based on IM motor you are using:

Parameters	Definition	Value
01-00	Induction motor max frequency (Hz)	50.00
01-01	Induction motor rated frequency (Hz)	50.00
01-02	Induction motor rated voltage (V)	380.0
05-01	Induction motor rated current (A)	2.13
05-02	Induction motor rated power (kW)	0.75
05-03	Induction motor rated speed (rpm)	1395
05-04	Induction motor pole numbers	4

3. Set 05-00=6 named IM flux curve dynamic tuning and press the【RUN】key for getting parameters 05-05 ~ 05-09 and weak flux parameters for sensorless.

Please be noticed that motor will run in 05-00=6 auto-tuning method.

4. Please check the following parameters after IM flux curve dynamic tuning.

05-05 IM No-load current, 05-06 IM Stator resistance, 05-07 IM Rotor resistance, 05-08 IM Lm, 05-09 IM Lx.

5. Set 05-00=12, to begin IM motor inertia auto-tuning

- Set 00-10=2, Torque mode;

- Set 00-13=2, TQC sensorless mode;
- Set 05-00=12, press 【RUN】 key to operate inertia estimation.
- Repeat to set 05-00=12 for operating inertia estimation until 11-01 is stable.

6. Set ASR parameters based on the practical situation.

- Please set 11-03 11-04 11-05 if we set 11-00=1 and finish the system inertia auto-tuning.
- Please set 11-06 to 11-11 if we set 11-00=0 which it doesn't need the system inertia auto-tuning.

7. How to set other special parameters.

Pr. no	Definition	Default value
10-24 (Bit 0)	<b>ASR control at TQC sensorless</b> 0: use PI as ASR; 1: use P as ASR.	0
10-24 (Bit 11)	<b>DC brake when executing zero torque command</b> 0: ON; 1: OFF.	0
10-24 (Bit 15)	<b>Direction limitation at TQC sensorless</b> 0: Open the direction limitation; 1: Close limitation.	0
10-25	<b>FOC bandwidth of speed observer. (Hz)</b> Setting higher of this value can decrease the speed response time, but it will create more noise interference.	40
10-26	<b>FOC Minimum Stator Frequency</b> Setting the minimum stator frequency in case the frequency command or limitation is too low.	2
10-27	<b>FOC Low-pass Filter Time Constant (ms)</b> When the motor can't be activated during the high-speed operation, please decrease the value of this parameter.	50
10-28	<b>FOC gain of excitation current rise time (ms)</b> When the drive's action time is too long at torque mode, please decrease the value of this parameter.	100
11-33	<b>Source of Torque command</b>	0
11-34	<b>Torque Command</b>	10

11-36	<b>Speed Limit Selection</b> 0: Set by Pr.11-37 and Pr.11-38; 1: Set by Pr.11-37, 11-38 and Pr.00-20; 2: Set by Pr.00-20.	0
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## Attentions:

### A. Do we must use the 05-00=6 method to auto-tune the motor parameters?

This measure (05-00=6) can include the weakness flux parameter auto-tuning for sensorless compared with Pr05-00=1. They all require empty load.

- If we don't need the weakness flux parameter auto-tuning, we can set Pr05-00=1. If there is no weakness flux parameter auto-tuning, FOC sensorless is OK when your frequency is under rated. But TQC sensorless is not very OK when your torque command is low.
- If the motor can't be separated from the load, we can set Pr05-00=2(static tuning). Pr. 05-05 must be input before we set Pr05-00=2 for static auto-tuning. This method will have the same weakness like Pr05-00=1. Besides, the motor parameters also can't be tuned very precisely under this method.

### B. Is inertia Auto-tuning optional or mandatory?

This measure (05-00=12) is only available for FOC/TQC sensorless control mode, and make sure the motor parameters (No\_load current, Rs, Rr, Lm, Lx) are set before we begin to inertia estimation. Inertia auto-tuning is for enhancing the output torque and ASR regulation ability against the variable loading inertia. So, it is optional not mandatory. Sometimes, if your loading situation is variable, we suggest you take it.

### C. Can we use C2000 TQC sensorless mode to work smoothly in any situation?

Actually, it is decided to your load situation. Normally, we can use C2000 TQC sensorless to work smoothly in 3Hz and 10% torque which are the least requirements. But if your load is light, even C2000 also can work smoothly less than 3Hz. However, our C2000 can't compare with ABB ACS800 DTC technology in low speed and low torque command.

### D. What is the essence of the Pr10-26 function?

The Pr10-26 is for minimum stator frequency. E.g. If 10-26=10, 01-00=50HZ, the minimum stator frequency is  $01-00 \times 10-26 / 100 = 5\text{HZ}$ , so when you frequency limitation is less than 5HZ, the output frequency will be 5HZ at least not follow your command totally.

It is not good for setting Pr10-26 too high or too low since the MRAS has one stable range for

operation successfully. Hence, we suggest please keep the default setting from Pr10-25~Pr10-28.

**E. Why the motor will run when the speed limit is zero and the torque command is not zero?**

This is a normal situation, because C2000 TQC sensorless is based on MRAS technology. And it can't calculate accurately when the motor work in very low speed. So even if we set speed limit is zero, but the motor also will run in about 3Hz to ensure the MRAS calculation accurately. We can set Pr.01-34=1 using DC brake mode, the motor will be hold when the speed limit is zero and torque command is not zero. However, the motor will run when the speed limit is above 3Hz because of ensuring the motor will work smoothly.

This situation is different with Pr10-26 mechanism, and 3HZ is fixed into firmware when your speed limitation is 0. Any other cases, Pr10-26 will be the minimum stator frequency.

**F. How to use the DC brake function when the torque command is zero?**

Actually, when the torque command is zero, the motor should not output torque.

However, in some special application, even if the torque command is zero, the motor also need to output zero speed torque, to avoid the load falling.

Therefore, we can set bit11 of Pr.10-24 to 0(default value) for adding DC brake when the torque command is zero. But the DC brake torque size can't be adjusted, it is fixed by firmware.

**G. How can we understand Pr.10-24 bit15?**

Our Sensorless Control in TQC only has a good test in electromotive mode. If we go to regenerative mode, the torque output will be very low when frequency limitation below 7HZ. So that is dangerous. Hence, we use Pr.10-24 bit 15 to 0 for opening direction limitation to prohibit the regenerative mode application.

Of course, if you set Pr.10-24 bit 15 to 1, the direction limitation also can be canceled and you can go to regenerative mode. But please ensure the speed limitation higher than 10HZ for safe. However we still don't suggest you set Pr.10-24 bit 15 to 1.

**H. If we need PG card in the TQC sensorless commissioning process?**

We don't need PG card and encoder including the motor parameters auto-tuning.

