Application Note - Baldor SynRM² Motor Startup Guidance

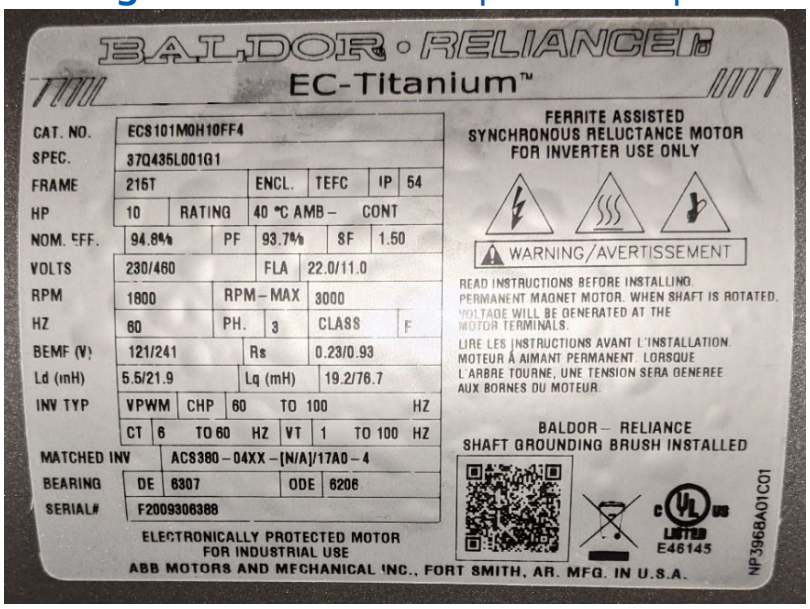
Overview

The purpose of this document is to provide basic guidance about how to program a Yaskawa drive to run a Baldor SynRM² motor, which is referred to as a ferrite-assisted synchronous reluctance motor. This document is relative specifically to the Baldor EC-Titanium branded motors.

Applicable Products:

A1000 | FP605 | GA500 | GA800 | HV600 | U1000 | V1000 | Z1000

Figure 1: Motor Nameplate Example



A quick glance at the nameplate for one of these motors reveals that it has specifications for Ld, Lq, and BEMF, common specifications normally seen on permanent magnet motor data sheets. Although this is a synchronous reluctance motor, the additional ferrite gives this motor some characteristics like that of a permanent magnet motor. Therefore, when setting up a Yaskawa drive to run this motor, start by setting parameter A1-02 to the appropriate PM control method based on the drive model. For the GEM series drives (FP605, HV600, GA500, and GA800), it is recommended to use the EZ Vector control method (A1-02=8). For the 1000 series drives (V1000, Z1000, A1000, and U1000), use the open loop vector/PM (OLV/PM) control method (A1-02=5).

Auto-Tuning

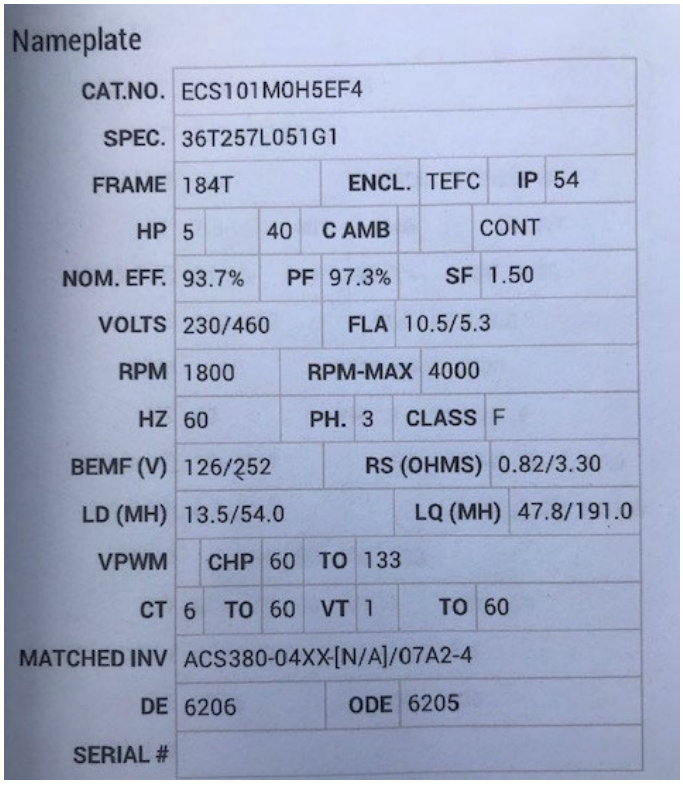
It is recommended to perform a rotational auto-tune on the motor with the load uncoupled. If the load is already coupled to the motor and it is not possible to uncouple, then a stationary auto-tune may suffice. Refer to the appropriate section in the drive manual for details on auto-tuning. If the auto-tune is not successful or the drive is not equipped for auto-tuning a PM motor (V1000, Z1000), then the motor settings must be entered into the drive manually. The motor nameplate will have the values

required for the motor settings in the drive. If the motor is mounted in a place such that viewing the nameplate is difficult or impossible, a data sheet provided by Baldor will be necessary.

Programming the Motor Settings Manually

Below is a Baldor data sheet for a SynRM² motor. Most of the values that are shown in the data sheet have units that match Yaskawa drive settings except for resistance and BEMF. Depending on the control method being used, the resistance will be programmed into either parameter E5-05 or E9-10. The data sheet shows 3.30 ohms (applies to 460 V motor winding configuration) which is in units of ohms line-to-line. The drive units for E5-05 are in ohms per-phase. To convert line-to-line to per-phase, divide 3.30 ohms by 2. In this example, the correct setting for E5-05 is 1.65 ohms. Not all of the other motor specifications need to be converted. Ld and Lq are already in per-phase. However, because the motor nameplate value for BEMF is at rated speed (1800 rpm), not per 1000 rpm as required by the drive, the BEMF value must be converted using this formula: 252V*1000/1800 = 140V/krpm.

Figure 2: Baldor Datasheet for SynRM^2 Motor



Nameplate

CAT.NO.	ECS101M0H5EF4						
SPEC.	36T257L051G1						
FRAME	184T	ENCL.	TEFC	IP	54		
HP	5	40	C AMB		CONT		
NOM. EFF.	93.7%	PF	97.3%	SF	1.50		
VOLTS	230/460	FLA	10.5/5.3				
RPM	1800	RPM-MAX	4000				
HZ	60	PH.	3	CLASS	F		
BEMF (V)	126/252	RS (OHMS)	0.82/3.30				
LD (MH)	13.5/54.0	LQ (MH)	47.8/191.0				
VPWM	CHP	60	TO	133			
CT	6	TO	60	VT	1	TO	60
MATCHED INV	ACS380-04XX-[N/A]/07A2-4						
DE	6206	ODE	6205				
SERIAL #							

The following is the minimum programming required before running using the data sheet (460 V winding) in an OLV/PM control mode. Please note the calculated values for resistance (E5-05) and BEMF (E5-24):

- A1-02 = 5
- E1-04 = 60 Hz
- E1-05 = 460 V
- E1-06 = 60 Hz
- E5-01 = FFFF
- E5-02 = 3.73 kW (5 HP)
- E5-03 = 5.3 A
- E5-04 = 4 poles

- E5-05 = 1.65 ohms/ph
- E5-06 = 54.0 mH/ph
- E5-07 = 191.0 mH/ph
- E5-09 = 0
- E5-24 = 140 V/krpm
- n8-62 = 460 V

The following is the minimum programming required before running using the same data sheet (460 V winding) in the EZ Vector control mode (A1-02=8). Please note the resistance units in parameter E9-10 are ohms line-to line. Therefore, no conversion for the resistance is required in EZ Vector control mode:

- A1-02 = 8
- E9-01 = 2
- E9-02 = 60 Hz
- E9-03 = 1800 RPM
- E9-04 = 60 Hz
- E9-05 = 460V
- E9-06 = 5.3 A
- E9-07 = 5 HP
- E9-08 = 4 poles
- E9-09 = 0 Hz
- E5-07 = 191.0 mH/pH
- E9-10 = 3.30 ohm/L-L
- n8-62 = 460 V

The Motor and Drive are Ready for a Test Run

Once the motor has been Auto-Tuned or the required settings described above have been entered manually, the next step is to run the motor. If possible, uncouple the motor from the load. Check for the correct motor rotation by initiating a FWD run command. If the direction is incorrect, shut off main power to the drive, wait until the charge LED on the drive is completely extinguished, then swap two output phases (motor leads). When the motor is rotating in the correct direction, run the motor at various speeds from 6 to 60 Hz in the forward direction (and reverse direction, if applicable). Please note it is usually easier to fine tune any additional parameter settings before you couple the motor and the load.

Additional Startup Settings to Consider

• Accel/decel times, C1-01 and C1-02 – Enter adequate times for the motor to accelerate/decelerate.

• S-curve settings, C2-01 through C2-04 – Set all 4 S-curve settings to 10.0 seconds.

• Speed search, b3-01 – Set to 1 for fan/blower applications.

• Short circuit braking time at start, b2-12 – Set to 10.0 seconds to help avoid STPo and ov faults at start.

• Pull in current at acceleration, n8-51 – Start at 35% and increase in increments of 5% if STPo faults occur during acceleration.

• Motor to load inertia ratio, n8-55 – Set to 3. Adjust per application.

• Dynamic audible noise control, S1-01 – Set to 0 to disable it (Z1000 and HV600).

Please note that many of these additional settings (or at least some) may be necessary if encountering STPo faults.