Operating Induction machines in AKD, using an open-loop Volts/Hz speed control

This article explains how to set an AKD for driving an asynchronous machine, using an open loop V/Hz strategy. The article contains:

- Introduction
- Initial settings
- Parameters
- Variables for analysis
- Further information
- Example

Introduction

The open loop volts/Hz (also known as volt/Frequency) scalar control of an induction motor is by far a popular method of sped control because of its simplicity. For adjustable speed applications, frequency control is natural. However voltage is required to be proportional to frequency so that the flux ($\psi_s = \frac{V_s}{\omega}$) remains constant (see Fig. 1), neglecting the stator resistance R_s drop. MOTOR.VOLTRATED and MOTOR.VRATED have to be set according to machine parameters from data sheet. Then, the output V/Hz is automatically adjusted. This will work as long as the supplied voltage is high enough to allow the induction machine to reach the speed command. Since the algorithm neglects the voltage drop in the resistance, a boost voltage should be added so that the rated flux and corresponding full torque are available at zero or low speed. In AKD, this boost voltage is set through MOTOR.VOLTMIN.
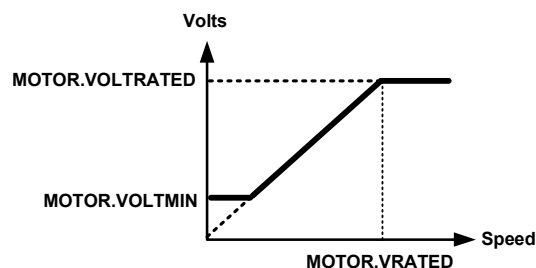

Figure 1: Relationship Voltage/Frequency

Figure 2 shows the block diagram of the volts/Hz speed control method that is implemented in AKD.
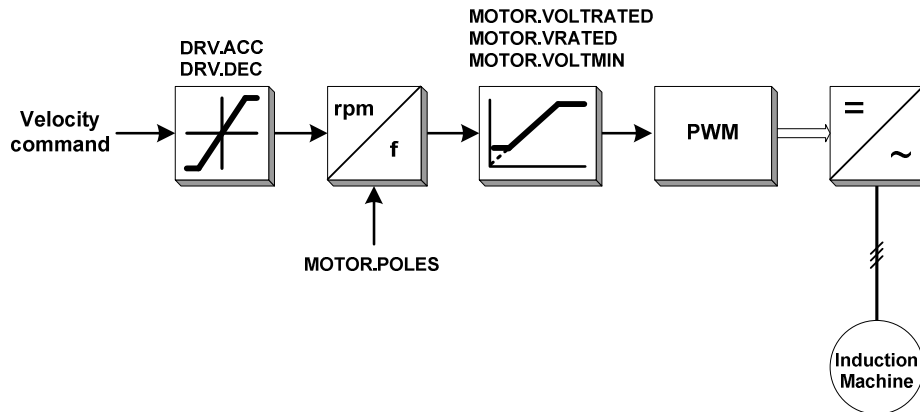

Figure 2: V/Hz scheme

The velocity command can be obtained from three different sources, depending on DRV.CMDSOURCE:

- 0: Service
- 1: Field bus
- 3: Analog

Initial settings

DRV.OPMODE = 1   Velocity mode
MOTOR.TYPE = 2   V/Hz speed control
FB1.SELECT = 1   None feedback
DRV.ACC & DRV.DEC   Set according to induction machine mechanical dynamics

Parameters

The following table shows which MOTOR parameters should be also configured for driving induction machines under V/Hz open-loop operation:

Keyword	Induction Motor V/f Open Loop	Description
MOTOR.NAME	Yes	Set a name for customer motor
MOTOR.TYPE	Yes	Set to motor type. For V/Hz, MOTOR.TYPE = 2
MOTOR.AUTOSET	No	No available in V/Hz
MOTOR.IPEAK	Yes	Set to motor peak current (A). 150% of continuous current for NEMA motors
MOTOR.ICONT	Yes	Set to motor continuous current (A)

MOTOR.INERTIA	Yes	Set the motor inertia in kg cm^2
MOTOR.KT	No	No necessary for Induction Motor
MOTOR.LQLL	No	No necessary for V/Hz
MOTOR.POLES	Yes	Set to motor poles
MOTOR.VMAX	Yes	This is the maximum mechanical speed of the motor in RPM
MOTOR.R	Yes	Set the stator winding resistance phase-to-phase in Ohms
MOTOR.VOLTMAX	Yes	Motor max winding voltage. Ex: 230 VAC or 460VAC
MOTOR.PHASE	No	No necessary for Induction Motor
MOTOR.CTF0	Yes	This is used to configure the thermal constant of the motor coil
MOTOR.KE	No	No necessary for Induction Motor
MOTOR.IMTR	No	No necessary for V/Hz
MOTOR.IMID	No	No necessary for V/Hz
MOTOR.VOLTRATED	Yes	This is the rated voltage for the V/HZ curve.
MOTOR.VRATED	Yes	This is the rated velocity for the V/Hz curve
MOTOR.VOLTMIN	Yes	V/Hz drive, this is the starting voltage of the V/Hz curve in %. Ex: 5V is 2.1% of 230V so set MOTOR.VOLTMIN to "2%" for 5V

Variables for analysis

Following variables are available for analysis and supervision:

IL.CMD	Since there is no cascade structure, no current loop is present. However, this shows a track similar to the speed command. The relationship is dependent on MOTOR.VRATED
IL.FB	Currently current at motor terminals

Further information

KOLLMORGEN Europe Product Wiki : Induction Machine -General

KOLLMORGEN Europe Product WIKI : Sensorless Control for Induction Machines with S300-S700

Example:

Considering the following ASM:

Nominal voltage = 230/460V	Nominal current = 8.75/5.05A	4 poles
Power: 2.20Kw	Nominal speed = 1395 rpm	
cos φ = 0.82	Nominal frequency = 50Hz	

We set following parameters in AKD:

Parameter	Value	Parameter	Value
DRV.ACC & DRV.DEC	10000rpm/s	MOTOR.POLES	4
DRV.OPMODE	1	MOTOR.VMAX	1600 rpm
FB1.SELECT	1	MOTOR.R	1.12 ohm
MOTOR.NAME	NORD-ASM	MOTOR.VOLTMAX	240V
MOTOR.TYPE	2	MOTOR.VOLTRATED	230
MOTOR.IPEAK	13 A	MOTOR.VRATED	1395 rpm
MOTOR.ICONT	8.75 A	MOTOR.VOLTMIN	2%
MOTOR.INERTIA	6.2 kg cm^2		

Speed command: 1395 rpm