Tech Tip

Topic:	Sensorless Flying Start Operation
Drive Product:	PowerFlex 700S

Introduction

A Tech Tip provides details on a specific feature of a drive product and provides configuration and tuning information on the parameters associated with that specific feature.

User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.ab.com/documents/gi) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this document are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Related Publications

The following publications should be referenced and followed when operating, configuring, or commissioning this drive product. These publications may be found on the automation book store at www.theautomationbookstore.com ;

Publication Title	Pub Number
PowerFlex 700S User Manual	20D-UM001B-EN-P
PowerFlex 700S Reference Manual	PFlex-RM002A-EN-E
PowerFlex 700S Firmware Release Notes	20D-RN004A-EN-P
PowerFlex 700S Quick Start	20D-QS001A-EN-P

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Precautions

Class 1 LED Product

ATTENTION: Hazard of permanent eye damage exists when using optical transmission equipment. This product emits intense light and invisible radiation. Do not look into module ports or fiber optic cable connectors.

General Precautions

ATTENTION: This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference Allen Bradley publication 8000-4.5.2, "Guarding Against Electrostatic Damage" or any other applicable ESD protection handbook.

ATTENTION: An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors such as under sizing the motor, incorrect or inadequate AC supply, or excessive surrounding air temperatures may result in malfunction of the system.

ATTENTION: Only qualified personnel familiar with the PowerFlex 700S AC Drive and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

ATTENTION: To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before performing any work on the drive. Measure the DC bus voltage at the +DC & −DC terminals of the Power Terminal Block (refer to Chapter 1 in the PowerFlex 700S User Manual for location). The voltage must be zero.

ATTENTION: Risk of injury or equipment damage exists. DPI or SCANport host products must not be directly connected together via 1202 cables. Unpredictable behavior can result if two or more devices are connected in this manner.

ATTENTION: Risk of injury or equipment damage exists. Parameters 365 [Encdr0 Loss Cnfg] - 394 [VoltFdbkLossCnfg] let you determine the action of the drive in response to operating anomalies. Precautions should be taken to ensure that the settings of these parameters do not create hazards of injury or equipment damage.

ATTENTION: Risk of injury or equipment damage exists. Parameters 383 [SL CommLoss Data] - 392 [NetLoss DPI Cnfg] let you determine the action of the drive if communications are disrupted. You can set these parameters so the drive continues to run. Precautions should be taken to ensure the settings of these parameters do not create hazards of injury or equipment damage.

Technical Information

The sensorless flying start function implements a frequency search algorithm that searches for the rotor speed and when found provides flux up time for the motor before transitioning to normal operation. The frequency search algorithm searches for a motor voltage that corresponds with the excitation current applied to the motor. This function is useful where very large inertia systems that would take an extended period to come to a stop if a drive trip would occur or in cases where an external source may be moving the motor before the drive would be started.

The PowerFlex 700S must be version 1.017 or later to support sensorless flying start.

ATTENTION: The user must determine the safe frequency search configuration at the system level. Incorrect selection(s) may result in personal injury due to machine motion.

ATTENTION: The Flying Start function is only used for sensorless operation. In all other cases the motor speed is known from the feedback device and a normal start may be used even if the motor is rotating providing the user has determined that the system is safe for re-starting while rotating.

Sensorless Flying Start Operation

The sensorless flying start function runs a frequency search algorithm that searches for the rotor speed and when found provides flux up time for the motor before transitioning to normal operation. There two modes available for the frequency search, last known frequency and preset frequency search.

The last know frequency is the fastest method of flying start, with an initial search frequency starting at the last known operating frequency. This will search from the last known frequency toward zero frequency and if the motor speed is not found perform a start from zero speed. If the motor speed could reverse or increases to a larger speed a pull out or over voltage fault could occur. If a reversal or increase in motor speed could occur the preset frequency search should be used.

The preset frequency search start the frequency search at the value set in P451 [Fstart Speed]. From this initial search frequency the search will move towards zero. Once zero frequency is reached the algorithm will reset to the opposite direction at the same initial frequency and again search toward zero. If zero is reached a second time the drive will perform a start from zero speed. The preset frequency search routine may take the longest to execute. The value entered into P451 [Fstart Speed] should always be greater than the expected speed of the motor. If the motor speed is greater than the initial search frequency overvoltage trips could occur or the algorithm may not find the correct motor speed.

If the flying start function is active and the drive is started with the motor at zero speed the flying start search will add considerable extra delay to actually starting the motor.
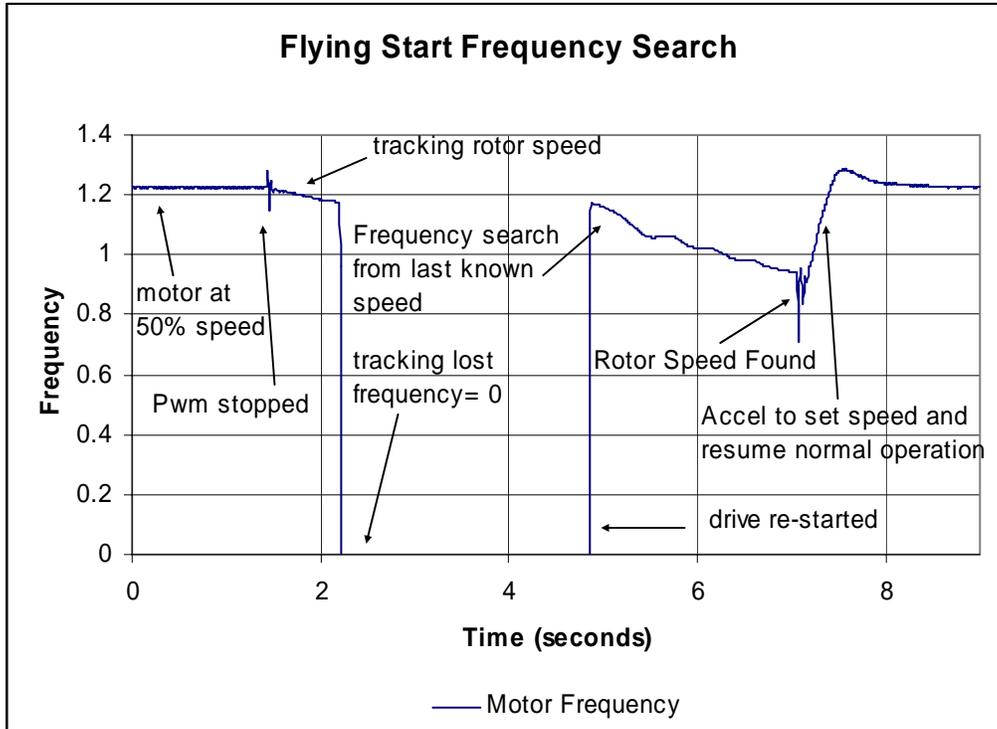
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Flying Start Frequency Search

Figure 1: Sensorless Flying Start From Last Known Speed
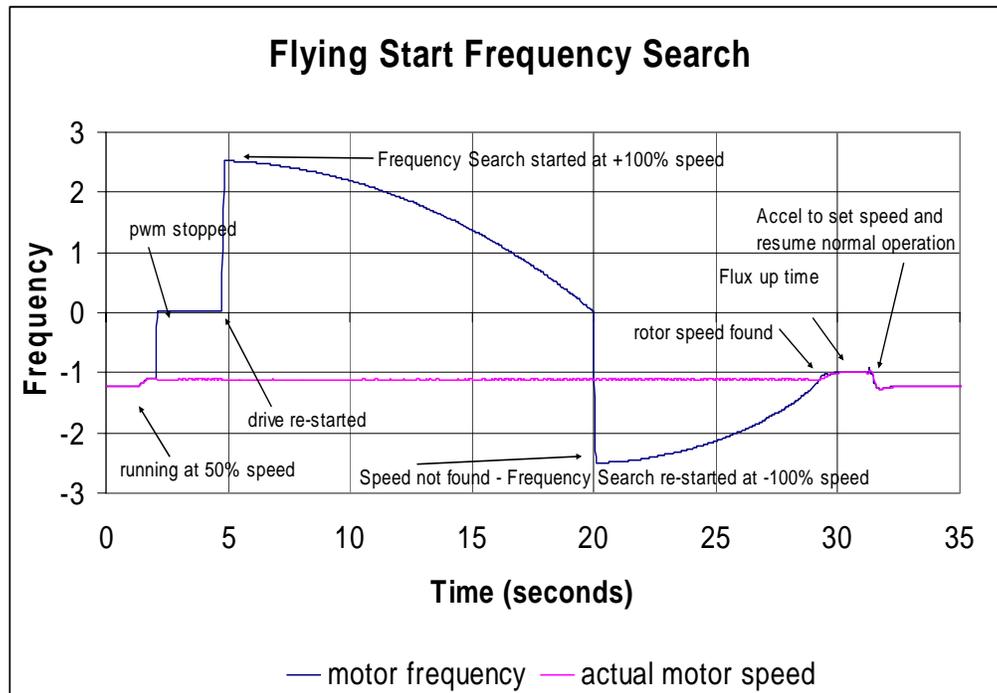
Flying Start Frequency Search

Figure 2: Sensorless Flying Start From Preset Speed

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<u>Sensorless Flying Start Configuration</u>
P30 [Rev Speed Limit] and P31 [Fwd Speed Limit] must be set to magnitudes greater than the value set in P451 [Fstart Speed] to avoid over speed faults during the preset frequency search.

P222 [Motor Fdbk Sel] selects the primary speed feedback device. This parameter must be set to 2 for sensorless flying start if this is the active feedback device.

P223 [Mtr Fdbk Alt Sel] selects the alternate speed feedback device. This parameter must be set to 2 for sensorless flying start if this is the active feedback device.

Settings for P222 [Motor Fdbk Sel] and P223 [Mtr Fdbk Alt Sel]:

0	Encoder 0
1	Encoder 1
2	Sensorless
3	Reserved
4	Motor Sim
5	FB Opt Port0
6	FB Opt Port1

P451 [Fstart Speed] Sets the initial frequency for the flying start frequency search. This value should always be set greater than the expected motor speed to avoid regeneration the chance of an over voltage fault.

P510 [FOC Mode Config] bit 23 "SrLssFStrtEn" set to a 1 enables the flying start function. When set to a 0 the flying start function is disabled.

P510 [FOC Mode Config] bit 26 "FS PresetSpd" set to 1 uses P451 [Fstart Speed] as initial frequency for the flying start. When set to 0 the flying start frequency search uses the last known frequency.

<u>Parameters Referenced</u>
P30 [Rev Speed Limit]
P31 [Fwd Speed Limit]
P222 [Motor Fdbk Sel]
P223 [Mtr Fdbk Alt Sel]
P451 [Fstart Speed]
P510 [FOC Mode Config] bit 23 "SrLssFStrtEn"
P510 [FOC Mode Config bit 24 "FS PresetSpd"

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