

Conflict rule with constant frequency references

ACH580 separate function and the conflict rule

We are often asked to provide multiple constant frequency reference setpoints in response to multiple, discrete digital inputs to the drive. The typical approach is to apply the constant frequency "Separate" mode in the ACH580 drive. This feature is useful for applications where known speeds are being requested for the driven loads like fans and pumps. As part of a good design we should anticipate... What will happen if two or more of the selected speeds are requested at the same time?

Good news is that there is a "conflict rule" already programmed into the Separate function. The objective for this technical note is to explain how conflicts for multiple requests at the same time are resolved.

The conflict rule

In the case of a conflict involving multiple requested speeds, the constant frequency with the smaller number takes priority. Should the selection point for CF1 and the selection point for CF2 be triggered at the same time then CF1, which is < CF2, will be used.

The Sequence of operation

We will demonstrate how the rule operates using a simple sequence of operation for a fan system with three speeds.

The "system" has 3 signals that will request the three desired speeds.

The requested speeds will be triggered by separate relay outputs wired into the drive's digital inputs (DI).

The requests will proceed in increasing order from Speed 1 to speed 3.

If two of the requests happen at the same time the drive is to maintain the previous speed until the conflict is cleared.

Input point:	DI1	DI2	DI3
Speed 1	1	0	0
Speed 2	0	1	0
Speed 3	0	0	1

Solving the application challenge...

The basic solution will pattern a typical 3 speed, constant frequency solution: (3) requests resulting in (3) discrete reference values.

We will be using the *Separate* function in the *Group 28 Frequency reference chain*. Specifically, the parameter; *28.21 Constant frequency function, Const freq mode [0] Separate* selection.

We will also use the *Constant speed* source for the Ext1 input source. With *Group 20 Start/stop/direction*, parameter *20.03 Ext1 in1 source* set to *[40] Constant speed* the drive will have a Start command and a speed reference when any of the DIs are selected.

This feature allows us to double up the benefit of a single DI. The triggering DI is both a Start command and a speed request at the same time. This will free up one of our DI points.

Example 1 Increasing reference values: Sel1 with CF1 lowest ascending to Sel3 with CF3 highest

For this application we will use the *Constant speed* source for the External 1 input source.

The desired speeds are ascending in values. The assumption is that the progression in speeds will be from low-to-high.

Associating values and selection points

Speed1 = 33 Hz with a DI1 input

Speed2 = 44Hz with a DI2 input

Speed3 = 55Hz with a DI3 input

Group 28 Frequency reference chain

28.21 Constant frequency function [0] Separate

28.22 Constant frequency sel1 [2] DI1

28.23 Constant frequency sel2 [3] DI2

28.24 Constant frequency sel3 [4] DI3

In this set-up the Speed1, 2, 3 values have a direct relationship with the constant frequency CF1, CF2, CF3 values. The sel1, 2, 3 are triggered by the customer Relay Outputs wired to the drive's digital Inputs; DI1, DI2, DI3. Everything is aligned in an ascending order with a direct relationship between the requested speed and the selected frequency in an increasing progression.

Constant frequency reference values

28.26 Constant frequency 1 33.00 Hz (Speed1)

28.27 Constant frequency 2 44.00 Hz (Speed2)

28.28 Constant frequency 3 55.00 Hz (Speed3)

Note: The constant frequency "n" is hard coded to the Selection point "n". i.e. sel1 to CF1, sel2 to CF2, sel3 to CF3, etc.

Ascending sequence

If DI1... then sel1; therefore, CF1 = 33.00 Hz

If DI1 and DI2... then sel1 and sel2; therefore, sel1 and CF1 = 33.00 Hz

If DI2... then sel2; therefore, CF2 = 44.00 Hz

If DI2 and DI3... then sel2 and sel3; therefore, sel2 and CF2 = 44.00 Hz

If DI3... then sel3; therefore, CF3 = 55.00 Hz

If DI1 and DI2 and DI3... then sel1 and sel2 and sel3; therefore, sel1 and CF1 = 33.00 Hz

Descending sequence

If DI3... then sel3; therefore, CF3 = 55.00 Hz

If DI3 and DI2... then sel3 and sel2; therefore, sel2 and CF2 = 44.00 Hz

If DI2... then sel2; therefore, CF2 = 44.00 Hz

If DI2 and DI1... then sel2 and sel1; therefore, sel1 and CF1 = 33.00 Hz

If DI1... then sel1; therefore, CF1 = 33.00 Hz

If DI1 and DI2 and DI3... then sel1 and sel2 and sel3; therefore, sel1 and CF1 = 33.00 Hz

Conclusions

As the speed request increases from speed 1 to 2 to 3 the drive reference value is increased from 33 Hz to 44 Hz to 55 Hz.

As conflicts occurred in the requests on the way up the previous speed value was maintained.

In the descending sequence the speed reference was set to the lower speed, as soon as, the lower speed request was true even if there was a conflict.

If all three requests are true at the same time, the system goes to the lowest speed.

The system was slower to increase speeds on the way up and faster to reduce speeds on the way down.

Example 2 Reversing the reference values: Sel1 with CF1 highest, descending to Sel3 with CF3 lowest

For this application we will use the *Constant speed* source for the External 1 input source.

In this set-up the Speed1, 2, 3 values have a reverse relationship, high-to-low, with the constant frequency points: CF1, CF2, CF3. The sel1, 2, 3 points are reordered as well. DI1 calls sel3 for CF3, DI2 calls sel2 for CF2, and DI3 calls sel1 for CF1.

Everything is aligned in an ascending order with a reverse relationship between the requested speed and the selected frequency. We will still be providing an increasing speed reference in response to the increasing speed request. The only change is that we have reversed the sequence the constant frequency values; CF1, CF2, CF3.

Assigning

Speed1 = 33 Hz with a DI1 input

Speed2 = 44Hz with a DI2 input

Speed3 = 55Hz with a DI3 input

Group 28 Frequency reference chain

28.21 Constant frequency function [0] Separate

28.22 Constant frequency sel1 [2] DI3

28.23 Constant frequency sel2 [3] DI2

28.24 Constant frequency sel3 [4] DI1

Constant frequency reference values

You can re-sequence the speed reference Hz values by associating the higher Hz values with the lower constant frequency register. This change in the logic can provide a different result. The key is to pay attention to the sequencing of the CF points and the values programmed into the CF registers.

28.26 Constant frequency 1 55.00 Hz (Speed3)

28.27 Constant frequency 2 44.00 Hz (Speed2)

28.28 Constant frequency 3 33.00 Hz (Speed1)

Ascending sequence

If DI1... then sel3; therefore, CF3 = 33.00 Hz

If DI1 and DI2... then sel3 and sel2; therefore, sel2 and CF2 = 44.00 Hz

If DI2... then sel2; therefore, CF2 = 44.00 Hz

If DI2 and DI3... then sel2 and sel1; therefore, sel1 and CF1 = 55.00 Hz

If DI3... then sel1; therefore, sel1 and CF1 = 55.00 Hz

If DI1 and DI2 and DI3... then sel3 and sel2 and sel1; therefore, sel1 and CF1 = 55.00 Hz

Descending sequence

If DI3... then sel1; therefore, sel1 and CF1 = 55.00 Hz

If DI3 and DI2... then sel1 and sel2; therefore, sel1 and CF1 = 55.00 Hz

If DI2... then sel2; therefore, CF2 = 44.00 Hz

If DI2 and DI1... then sel2 and sel3; therefore, sel2 and CF2 = 44.00 Hz

If DI1... then sel3; therefore, CF3 = 33.00 Hz

If DI1 and DI2 and DI3... then sel3 and sel2 and sel1; therefore, sel1 and CF1 = 55.00 Hz

Conclusions

As the speed request increased from speed 1 to 2 to 3 the drive reference value is increased from 33 Hz to 44 Hz to 55 Hz.

In the ascending sequence if a conflict occurred, the previous speed value was not maintained. The drive reference was immediately changed to the next higher speed.

If there was a conflict on the way down the drive maintains the previous speed. Maintaining the higher speed until resolved.

If all three requests are true, the system goes to the highest speed.

The system was faster to increase speeds on the way up and slower to reduce speeds on the way down.

Takeaways

In the case of a conflict involving multiple requested speeds, the constant frequency with the smaller number takes priority.

This is always true with the ; 28.21 *Constant frequency function, Const freq mode [0] Separate* selection.

It does not apply if the *Const freq mode [1] Packed* is used.

Recognizing that the relative order of frequency values; high-to-low vs. low-to-high can offer a different result in the way the drive changes to the new speed request. The conflict rule can be used to immediately select or delay the next speed reference value during request conflicts. Depending on the application the you can increase the speed more conservatively when pressurizing or maintain higher flow rates as the system speeds are reduced.

In the first example the constant frequency values are programmed with a direct relationship, low-to-high, between the requested speeds and the constant frequency values. On the way up the drive's reference value maintains the previous speed until the conflict with the next higher speed request is resolved. On the way down the lower speed becomes the drive's reference value immediately. So, the system was slower to increase speeds on the way up and faster to reduce speeds on the way down. The system goes to the lowest speed if all three speeds are requested.

In the second example, because we rearranged the speed values from high-to-low the drive's reference speeds progress to the next higher speed immediately on the way up even if there is a conflict. On the way down the previous speed values are maintained during a conflict. The reference changes to the lower speed when the request conflict resolves.

Reversing the values in the constant frequency registers makes the system more responsive while increasing the speed and is more conservative maintaining the higher speed refence during conflicts as the requests are reduced. The system goes to the highest speed if all three speeds are requested.

Remember that the acceleration and deceleration rates will also influence the system responsiveness. Open systems may be more tolerant of faster responses while closed systems may need a more conservative response when building pressures. Know the system, what it can handle and how fast, or slow, it needs to respond.

Hopefully the two examples helped you understand how the conflict rule operates in the constant frequency function, Separate mode and that how you arrange and select the relative constant frequency values can influence the system operation.