# ACS880 TORQUE CONTROL FOLLOWER WITH SPEED WINDOW

*When operating in Torque control, a speed window function can be implemented to limit a Torque Follower's operating speed.  This can be useful in mechanically sloppy systems and when mechanical brake control is required.*
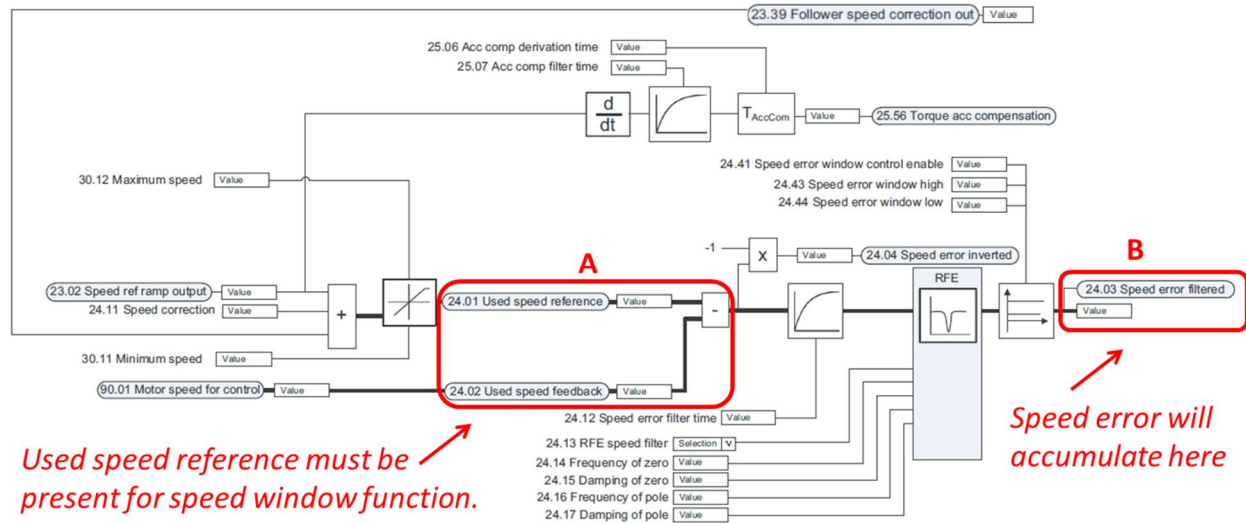
### Speed window control in Torque Follower:

The speed window function in a Torque Follower drive requires an active speed reference (passing through the speed reference chain while operating in Torque mode).  This requirement is not intuitive! The Torque Follower speed reference is enabled by selecting _M/F reference 1_ as the speed reference in Group 22 (Par. 22.11 or Par. 22.12).  The control mode of the Torque Follower must be set to ADD.

The Speed Master's _Used speed reference_ (Par. 24.01) and _Torque reference act 5_ (Par. 26.75) are passed to the Torque Follower via the D2D link (copper or fiber).  The _Used speed reference_ signal transmitted by the Speed Master is selected at M/F data 2 selection (Par. 61.02).  In the Torque Follower, the received signal is located at M/F data 2 selection (Par. 62.02) and is selected as _Ref1 16bit_.   The transmitted Speed Master _Torque reference act 5_ signal is set up at M/F data 3 selection (Par. 61.03). The Torque Follower signal received at M/F data 3 selection (Par. 62.03) is selected as _Ref2 16bit_.

If you are switching between Speed and Torque mode in the Follower, the Speed ref source in the Torque Follower should be selected at the same time M/F reference 2 is selected as the Torque ref1 source (Par. 26.11 or 26.12).  For example: If DI3 is used to select between Speed and Torque operating modes (DI3 = 1, Torque mode), then DI3 should be used to also select the speed reference (Par. 22.14). If you are not switching between torque references, it is perfectly acceptable to fix the torque reference selection as _Torque reference 1_ (Par. 26.14).

*Used speed reference must be present for speed window function.*

*Speed error will accumulate here*

The actual operating speed, designated as _Used speed feedback_ (Par. 24.02), represents motor speed (with or without an encoder). This signal is compared to the _Used speed reference_ (Par. 24.01), which represents the ramped/corrected speed. The difference between the two speeds is compared to the limits set in the speed window. If the difference is greater than the speed window limits, the drive switches to Speed mode to make a speed correction. When the difference is less than the speed window limits, the drive automatically switches back into Torque mode.

If the speed reference is not present at point A above, the speed error will be the same as your operating speed. The speed error will continuously grow from the time the drive is started – which is a key point to note. The speed window function has no effect at this point. *The speed error will push the Torque Follower's speed in the opposite direction!* If the Torque Follower is equipped with a brake chopper, it is possible that it will be active with any operation of the drive.

The Speed window control mode is selected via Par. 24.42. The Speed window function utilizes the tuning of the speed controller parameters in the Torque Follower (Par. 25.02 - Speed proportional gain, 25.03 - Speed integration time and 25.04 - Speed derivation time). _P-control_ uses the Speed proportional gain only. _Normal speed control_ uses all three control variables of the speed controller tuning (P, I and D). For the majority of applications, _P-control_ may be sufficient.

Note: *If the speed controller is tuned to be sluggish (not very responsive or slow to respond), it is possible that the speed correction can't be made quickly enough to stop the speed error from continuing to grow.* By observing the _Speed error filtered_ signal (Par. 24.03), you can easily determine if the speed controller tuning is the source of the problem. As long as the error value is within the Speed window limits, the error will not grow.

Setting the Speed error window high/low limits too tight may cause the drive to repeatedly jump between Torque and Speed modes, resulting in a noticeable growl in the motor. Wider limits may make the Torque Follower operation more forgiving (smoother) and take the growl out of the motor. Trial and error is required to determine an optimal setting.

A Speed window in a Torque Follower may reduce/eliminate load impacts when mechanical brake control is implemented on a Speed Master. If a Speed Master requires a torque build up (before brake release), a Torque Follower will provide uncontrolled motor acceleration. The speed window on the Torque Follower allows control of motor speed.

The following represents typical ACS880 parameter changes required to allow the operation of the speed window.

| | Torque controlled Follower | | | | Speed Master | |
|---|---|---|---|---|---|---|
| *Parameter* | *Description* | *Selection* | | *Parameter* | *Description* | *Selection* |
| Par. 19.11 | Ext1/Ext2 selection | DI3 | | | | |
| Par. 19.14 | Ext2 control mode | Add | | | | |
| Par. 22.11 | Speed ref1 source | M/F reference 1 | | | | |
| | OR | | | | | |
| Par. 22.12 | Speed ref12 source | M/F reference 1 | | | | |
| Par. 22.14 | Speed ref1/2 selection | DI3 | | | | |
| Par. 24.41 | Speed error window control enable | Enable | | | | |
| Par. 24.42 | Speed window control mode | * P-control | | | | |
| Par. 24.43 | Speed error window high | ** 10 | | | | |
| Par. 24.44 | Speed error window low | ** 10 | | | | |
| Par. 26.11 | Torque ref1 source | M/F reference 2 | | | | |
| Par. 26.14 | Torque ref1/2 selection | Torque reference 1 | | | | |
| | | | | Par. 60.10 | M/F ref1 type | Speed |
| | | | | Par. 60.11 | M/F ref2 type | Torque |
| Par. 62.02 | M/F data 2 selection (RxD) | Ref1 16bit | <--- | Par. 61.02 | M/F data 2 selection (TxD) | Used speed reference |
| Par. 62.03 | M/F data 3 selection (RxD) | Ref2 16bit | <--- | Par. 61.03 | M/F data 3 selection (TxD) | Torque reference act 5 |

*Suitable for most applications (no speed controller integration or derivation time applied)

**Application dependent setting

## Documents or other reference material:

ACS800/880 Master Follower Guide