

2.8

Servo filter adjustment

2.8.1 Servo filter adjustment

The MAC motor contains a higher-order digital filter regulation core. The purpose of the filter is to ensure that the desired speed, torque and/or position are achieved and secondly that stability is obtained.

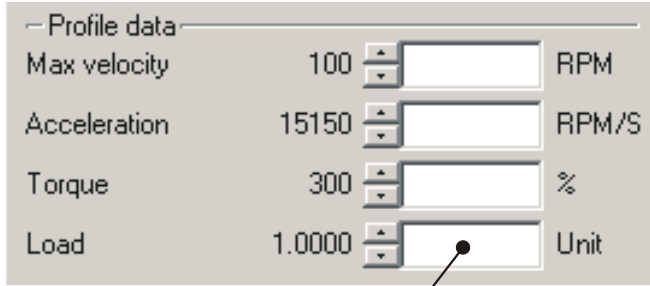
The motor's default setting (when delivered) is normally appropriate for most applications. The only necessary adjustment is the *LOAD* parameter which is available via the *Main* setup in the MacTalk software. For more demanding applications, the *Filter selector* can be used.

2.8.2 Adjusting the LOAD parameter

The *LOAD* parameter must be increased proportional to the inertia of the payload in the system. The default value of the *LOAD* parameter is 1.0000.

The proper *LOAD* value must be determined as follows.

$LOAD = (\text{Motor inertia} + \text{Load inertia}) / \text{Motor inertia}$.



Adjust Load according to the attached inertia.

Example:
A system uses a MAC800. The MAC800 has a motor inertia of 0.92kg/cm² (according to technical data in appendix). If the load inertia is 9.2kg/cm² (motor inertia x 10) the Load needs to be adjusted to

$$LOAD = (\text{Motor inertia} + \text{Load inertia}) / \text{Motor inertia}$$
$$LOAD = (0.92 + 9.2) / 0.92 = 11$$

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If the load inertia is not fully known, it is highly recommended to slowly increase the *LOAD* parameter until the motor starts to be unstable and noisy. Then decrease the value 20-30% to obtain a certain safety margin.

Remember to save the adjustment permanently in the motor by pressing the "Save in flash" button.

2.8.3 Exceptions when adjusting LOAD

Precautions must be taken if the transmission from the motor to the load is elastic or involves a certain amount of backlash. A typical situation where precautions must be taken is when using a belt drive actuator, since the motor's forces may have to be transmitted past a gear, for example, and then the belt until the payload is finally met. This "transmission chain" is typically very elastic and the gear will contain a certain amount of backlash. The main problem is that the motor does not directly "see" the final payload.

When the motor starts to rotate, it will not "sense" the payload before the backlash distance is passed and the belt is tightened. It is therefore not a linear system and the *LOAD* cannot be increased as much as in theory.

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2.8.4 Filter selector basics

If the desired motor response cannot be achieved using only the LOAD parameter, the filter selector can be used.

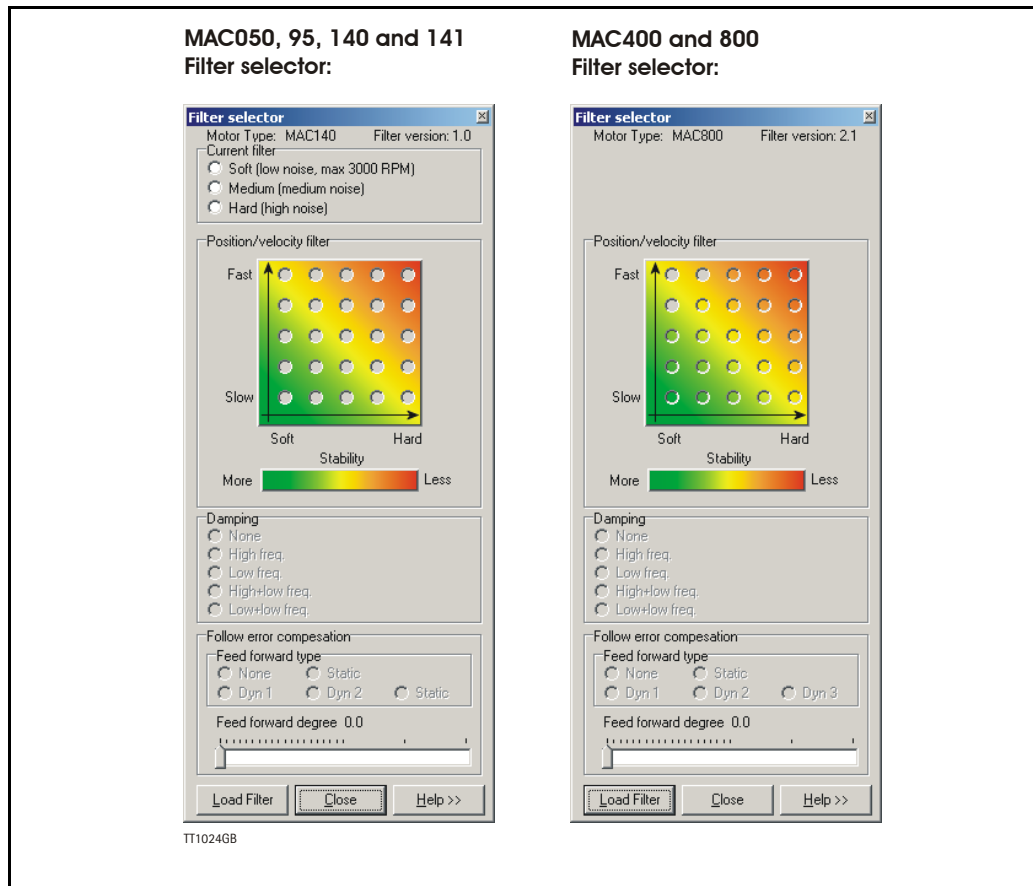
The filter selector can be found in the MacTalk upper toolbar.



Using the Filter selector, the “personality” of the motor response can be optimised to specific applications. The following overall behaviours can be adjusted:

- Follow error during movement and/or when the motor is stationary.
- Stability with a high load inertia.
- Stability if the load inertia changes during operation.
- Motor noise

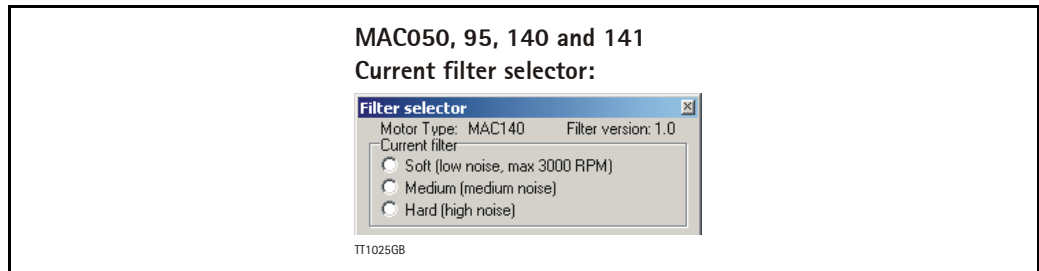
The filter selector is in principle the same for the complete MAC motor range except that the MAC50 to MAC141 also include the possibility to adjust the current filter.



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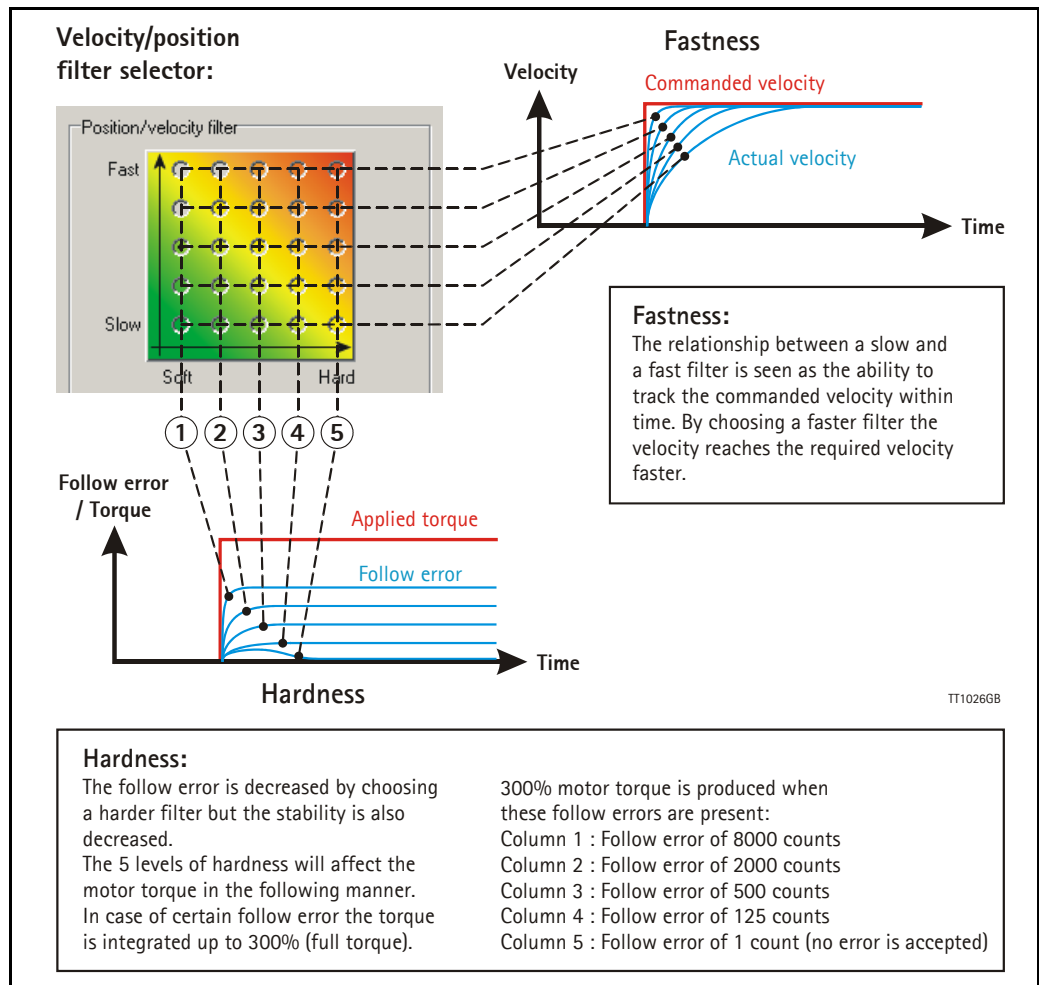
2.8.5 Adjusting the current filter (only MAC050 to 141)

The current filter is adjustable in the MAC050 to MAC141 models. This feature is useful if the audible noise from the motor needs to be decreased. Please note that the bandwidth of the current filter will also be lowered which can cause efficiency at higher speeds also to be lowered. As shown in the selector box below, it is not recommended to select the “Low noise” filter if the motor is operated above 3000 RPM (MAC141: 2000 RPM). A general recommendation is to select the high noise filter since it has the best dynamic performance.



2.8.6 Adjusting the Position/Velocity filter

The Position/Velocity filter is the main filter which sets up the main response performance of the motor.



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2.8.7 Damping

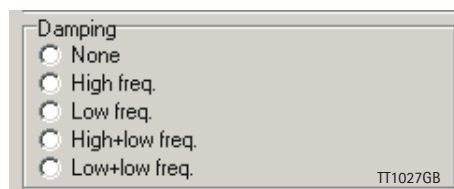
In almost any application it can be useful to damp (suppress) certain oscillations.

The damping selector can be used for this purpose.

The following damping types are available:

- **None**
Damping feature is disabled.
- **Low frequency**
When selecting *Low frequency*, oscillations caused by a poor mechanical transmission can be reduced. Poor mechanical transmission means backlash in the coupling or elastic toothbelts, etc. The filter becomes more tolerant to variations in the inertia which normally can cause the motor to become unstable.
- **High frequency**
When selecting *High frequency*, oscillations at higher frequencies will be reduced. This can typically occur if the filter starts to oscillate at a frequency related to the sample frequency. Often this can be heard as an audible noise.
- **High+Low frequency** (only available on MAC400-800)
This is a combination of High and Low frequency settings.
- **Low+Low frequency** (only available on MAC400-800)
This setting is similar to Low frequency but adds extra tolerance to variations in the inertia.

Damping selector:



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2.8.8 Follow error compensation

This feature makes it possible to achieve a minimum position error during movement (dynamically). The 2 main types are:

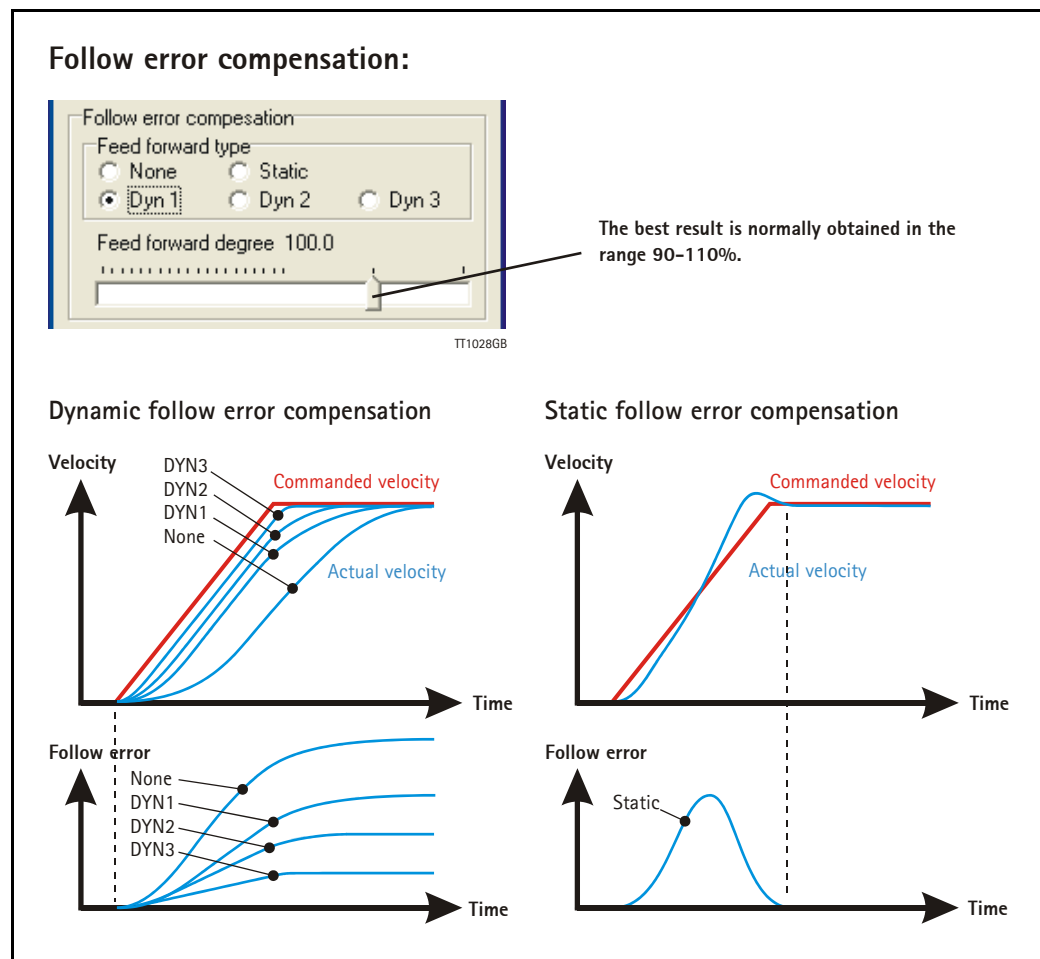
- **Static**

Will reduce follow error at constant speed, which can be useful for electronic gear applications since the motor will follow exactly what is demanded without any position error.

- **Dynamic**

Will reduce follow error during acceleration or deceleration (speed changes). This feature is intended to be used for applications which require that a commanded speed or target position is reached as fast as possible but without any overshoots etc.

The Dynamic compensation provides 3 levels (Dyn 1 to 3). Using a higher Dyn number, the filter order is increased and better performance may be possible, but will depend on the actual application.

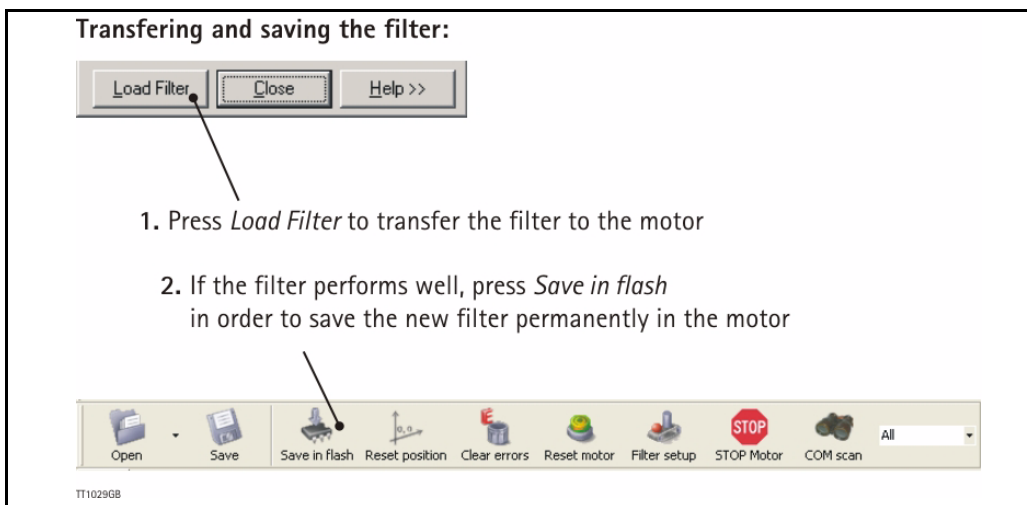


Please note that the dynamic compensation level Dyn 3 is only available on the MAC400-800 but for all motor sizes the available dynamic compensation is limited to Dyn 1 or 2 if a slow main filter is selected.

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2.8.9 Transferring and saving the filter

After setting the filter choices, the filter can be transferred to the motor.



The complete setup including the filter configuration can also be saved to and later recalled from disc by using the *Open* and *Save* buttons in the toolbar.

2.8.10 Additional adjustment

Now the desired filter is set up in the motor and the performance can be tested. Further improvement may be required and typically it may be necessary to experiment in order to obtain an optimum result.

Please note that the **LOAD** parameter must still be used to adjust the inertia ratio between the motor and load. See also *Adjusting the LOAD parameter*, page 43.