# Cyclical filter

Translation of the "Original Dokumentation"


**Name:** FKT_Zyklisches_Filter_en

**Version:**

| Version: 2019/45 | |
|---|---|
| **Change** | **Letter symbol** |
| • Controller card KW-R27 added | STL |

**Previous version:** 2018/44

**Product version:**

| Product (AMK part no.) | Firmware Version (AMK part no.) |
|---|---|
| KW-R06 (O835)<br>KW-R07 (O807)<br>KW-R16 (O872)<br>KW-R17 (O873) | AE-R05/R06 V1.10 2013/15 (204486) |
| KW-R24 (O901) | AE-R24 V2.03 2015/06 (205587) |
| KW-R24-R (O954) | AE-R24-R V2.11 2016/46 (206643) |
| KW-R25 (O902) | AE-R25 V2.03 2015/06 (205588) |
| KW-R26 (O903) | AE-R26 V2.03 2015/06 (205589) |
| KW-R27 (O957) | AE-R26 V2.12 2018/40 (207284) |
| iX / iC / iDT5 / | iX V1.03 2013/18 (204515) |
| iX(-R3) / iC(-R3) / iDT5(-R3) / | iX V2.08 2015/46 (206017) |
| ihXT | ihX V1.00 2015/06 (205440) |

**Publisher:**
AMK Arnold Müller GmbH & Co. KG
Gaußstraße 37 – 39,
D-73230 Kirchheim/Teck
Germany
Phone: +49 7021/50 05-0,
Fax: +49 7021/50 05-176
E-Mail: info@amk-group.com
Homepage: www.amk-group.com
Personally liable shareholder: AMK Verwaltungsgesellschaft mbH, Kirchheim/Teck
Registration court: Stuttgart HRB 231283; HRA 230681

# 1 Cyclical filter

| | |
|---|---|
| Supported hardware: | KW-R06 / KW-R16 / KW-R07 / KW-R17 / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / |

With many applications a regular speed ripple can be observed. It is typically caused by the permanent magnets in the rotor of a synchronous motor (cogging), by diffusion or drift in the motor current recording or by mechanical imbalance at the motor shaft and possibly behind a gearbox output.

Cogging or mechanical imbalance are not eliminated by the controller. It can only counter it and thus reduce the speed deviations!

The function of the cyclical filter can be used with position or speed control.

## 2 Relevant parameters

| Parameter | Name | Meaning<br>See document 'Parameter description' (AMK part no. 203704) |
|---|---|---|
| ID32916 | 'Cyclic filter' | List parameter |
| ID32916-2 1) | 'Maximum feedforward' | Limitation of the feedforward by the cyclic filter |
| ID32916-3 1) | 'Sensitivity' | Sensitivity of the cyclic filter |
| ID32916-4 3) | 'Display offset' | Is currently not operated |
| ID32916-5 1) | 'n. harmonic' | e.g. number of poles |
| ID32916-6 3) | 'Sine amount of the n. harmonic' | Is currently not operated |
| ID32916-7 3) | 'Cosine amount of the n. harmonic' | Is currently not operated |
| ID32916-8 1) | 'm. harmonic' | e.g. harmonics per motor rotation |
| ID32916-9 3) | 'Sine amount of the m. harmonic' | Is currently not operated |
| ID32916-10 3) | 'Cosine amount of the m. harmonic' | Is currently not operated |
| ID32915 3) | 'Sum of additive torques' | Display of the total from ID81 'Additive torque command value' and the internal torque feed forward values |

1) The parameter value must be set specific to the application

3) Parameter value is automatically generated by the controller card

# 3 Startup instructions

## 3.1 Determining the harmonics

A Fourier analysis can be carried out to determine the harmonics of the drive.

**Oscilloscope function in AIPEX PRO**

A simpler option is to record the parameters ID40, 'Velocity feedback value', and ID84, 'Torque feedback value', as well as ID33104, 'Position feedback modulo', using the oscilloscope function in AIPEX PRO (cf. the image 'Cyclical filter inactive') and from this oscillogram count the number of harmonics within a motor revolution.

This number is entered as an harmonic in the 5th list element of the parameter ID32916 'Cyclic filter'.

With this value, the next step is to rerecord the three parameters and if necessary determine a further harmonic from the oscillogram and enter it as the 8th list element.

**Drive and motor geometry**

A further option for determining the harmonics is the geometries of the motor and machine:

- Number of poles of the rotor and number of grooves
- Mechanical imbalance at the motor shaft
- Mechanical imbalance behind a gearbox output

The number of poles can be found in the motor's model name:

| **Dx x - x - NN - x x x - xxxx** | |
|---|---|
| \| \| \| \| \| \| \| | Idling speed |
| \| \| \| \| \| \| | Cooling |
| \| \| \| \| \| | Brakes |
| \| \| \| \| | Encoder |
| \| \| \| | **Number of poles** |
| \| \| | Index number of bar length |
| \| | Installation size |
| | Motor type |

This value is entered as the 5th list element in the parameter ID32916 'Cyclic filter'.

The other harmonic results from the number of grooves by determining the next number divisible by 3 based on the number of poles:

number of poles = 10, next number divisible by 3 = 12

This value provides the 8th list element.

## 3.2 Maximum feed forward and sensitivity

In order to avoid an overreaction of the filter, e.g. by bringing the motor up to speed, the additive torque generated by the filter is limited (cf. ID32915 'Sum of additive torques') and the sensitivity of the filter output is preset.

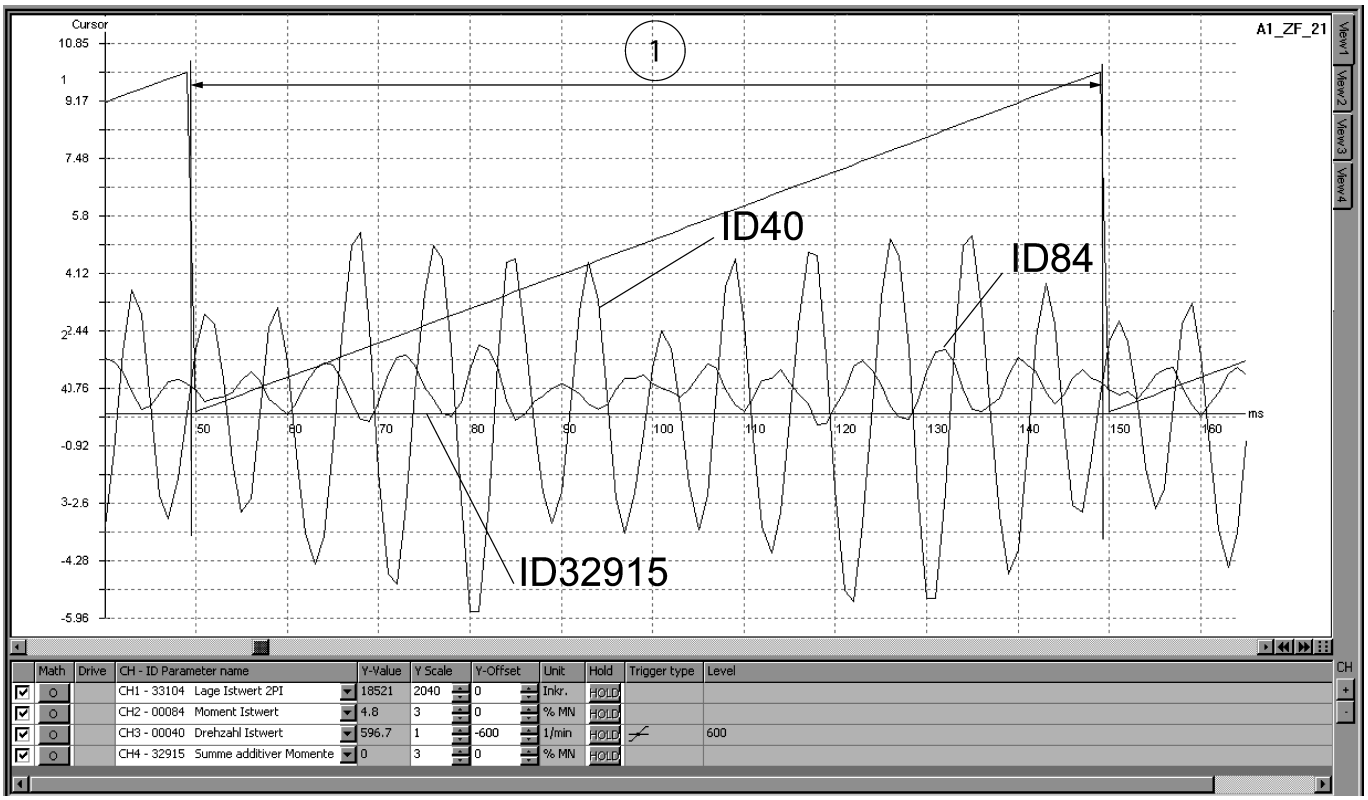
These values are to be entered in the 2nd and 3rd elements of the list parameter ID32916 'Cyclic filter'.

## 4 Development of the cyclical filter

An observer in the firmware of the controller card recognizes the speed ripple over several cycles, assesses it and generates an additive torque which overlays the torque setpoint. This overlaying of the two setpoints reduces the ripple at the motor shaft.

The following oscillograms show the effect of the cyclical filter:

**cyclical filter inactive**

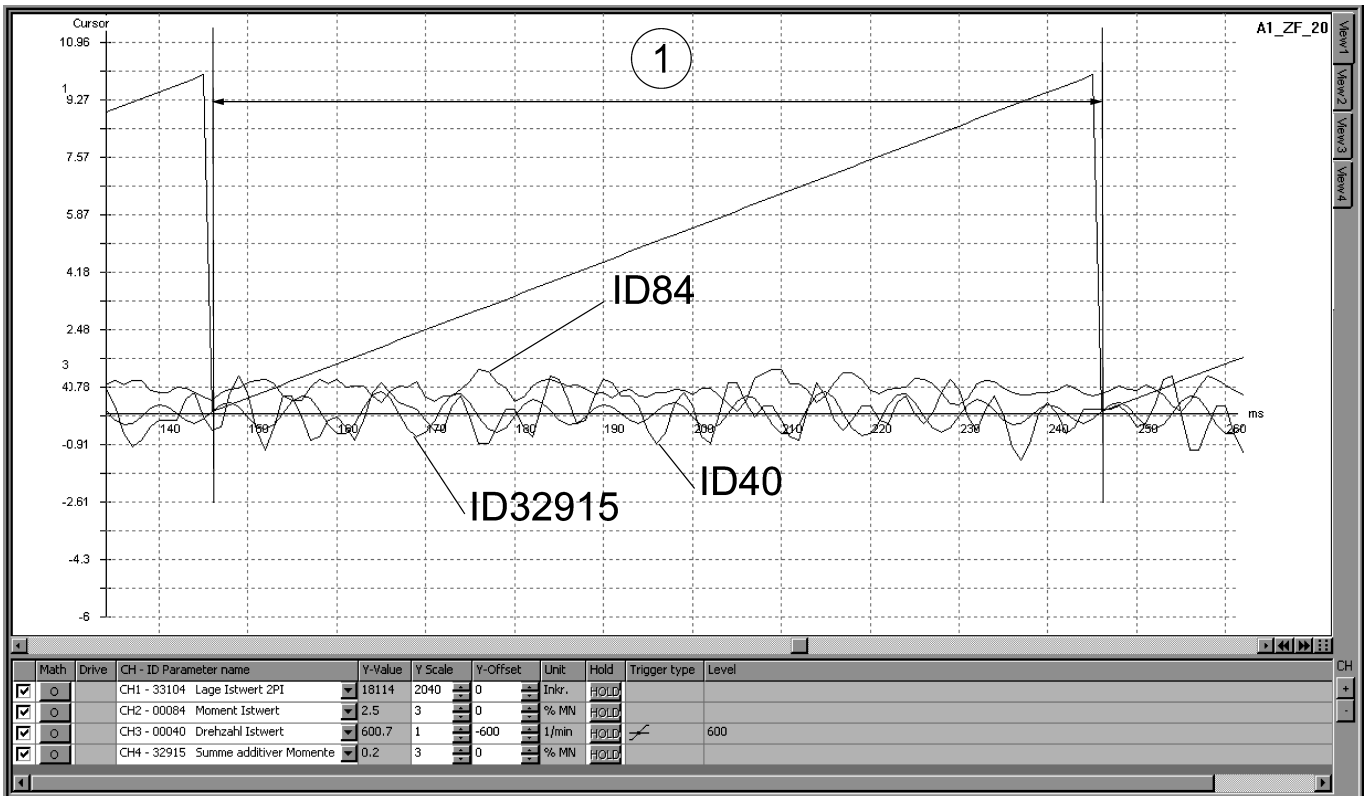



| | |
|---|---|
| 1 | 1 motor revolution |
| ID40 | 'Velocity feedback value' |
| ID84 | 'Torque feedback value' |
| ID32915 | 'Sum of additive torques' |

**Cyclical filter active**

**ID32916 'Cyclic filter'**
(example of parametrization, curve shown below)

| List element | Meaning | Value |
|---|---|---|
| 2 | 'Maximum feedforward' | 0 |
| 3 | 'Sensitivity' | 0 |
| 5 | 'n. harmonic' | 10 |
| 8 | 'm. harmonic' | 12 |




1 1 motor revolution

ID40 'Velocity feedback value'

ID84 'Torque feedback value'

ID32915 'Sum of additive torques'

These graphs were recorded with a laboratory model without load.
With a real machine, the list elements 2 and 3 must be not equal to zero.