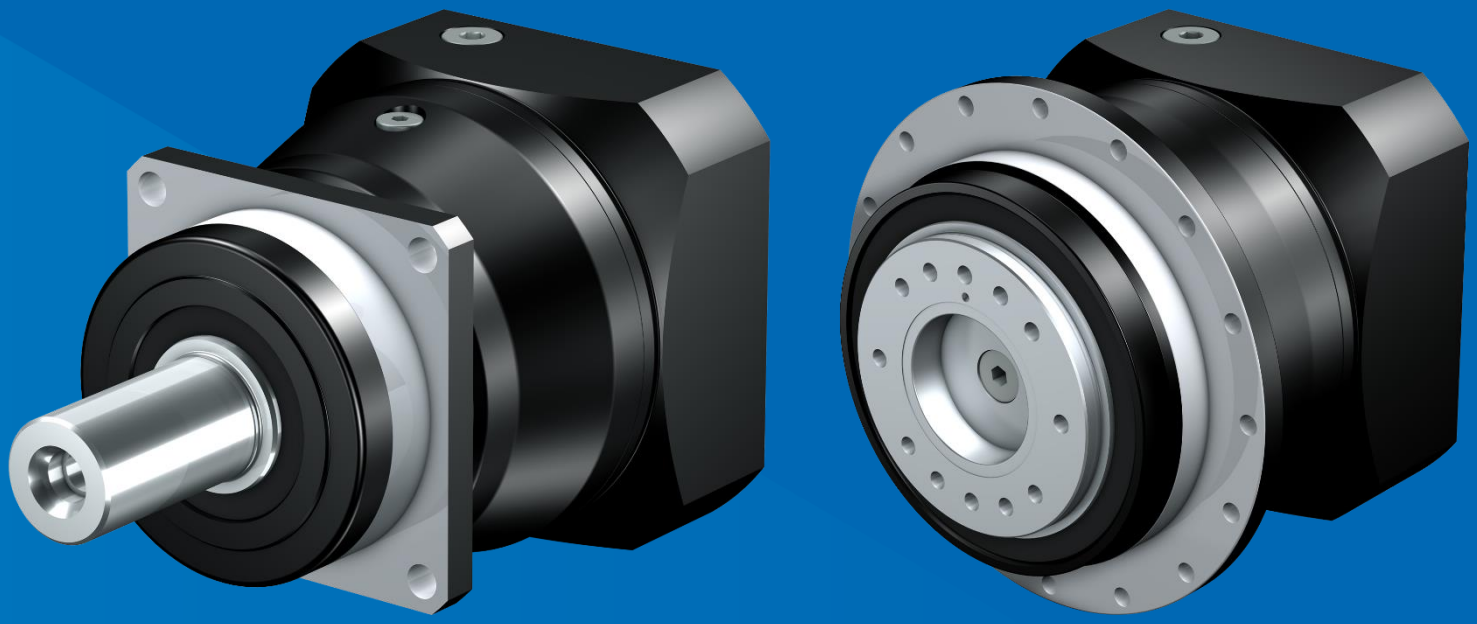


# Product Release Brief

## Planetary Gear Units
## Generation 3

SPG, April 2021

Version 1.4

STÖBER

# Content

# 1. Intension

This information is intended for internal use only.

It is an introduction to the new generation planetary gear. In it you will find all information and tools, for the conversion as well as sales support.

This Product Release letter and all documents referenced in this document are available at the following link:

https://stoebergermany-my.sharepoint.com/:f:/g/personal/ulla_goeransson_stoeber_de/EmVQn1U1dTFMgMsrYIxLjOgBBrzZ9F29Z80Y0RcgV8upg

Changes and errors excepted.

## 1.1 Intension New Generation

The current planetary gear series (G2) was launched in 2004.

In the meantime, many competitors have technologically catched-up, so that the products have become more and more similar and therefore more interchangeable. Regarding the visual appearance, which is becoming more and more important on the market, many gearboxes by cheaper competitors now have a higher quality than the SAT gearboxes. A generational change only with a revised optical design is not sufficient for the customer.

For this reason, the following priorities have been set for the revision by the sales department:

1. Cost Reduction
2. Length Optimization
3. Design Optimization
4. Performance Optimization

Highest priority has the cost reduction in order to remain competitive in the future. The performance data of the current series are part of the benchmark and are not the focus.

# 2. Product Launch

## 2.1 Schedule

Generation 3 planetary gears are gradually being released for sale. With this step-by-step plan, the changeover should take place as smoothly as possible and with the lowest possible residual quantities of the G2 components.

| | |
|---|---|
| P2-P (A) 3-P (A) 4, PH (A) 3-PH (A) 4 and PHQ (A) 4: | 1st October 2019 |
| P (A) 5-P (A) 7, PH (A) 5-PH (A) 7 and PHQ (A) 5-PHQ (A) 7: | 1st March 2020 |
| P (A) 8-P9, PH (A) 8 and PHQ (A) 8: | 1st May 2020 |

Dates apply to order entry in SAP.

The delivery times for the G3 are identical to those of the G2.

## 2.2 Conversion Process - SAP

**Documentation and tools for the conversion:**

- Catalogs (information on this in chapter 8.1 Catalogs)
- Operating and installation instructions (Download center)
- Customer information on the conversion of planetary gearheads from G2 to G3
- STOBER Configurator (information on this in chapter 8.2 Internet / Intranet)
- The homepage (information in chapter 8.2 Internet / Intranet)
- SAP configurator
- CAD download
- Presentation Comparison G2 vs. G3
- Comparison charts of the most important criteria
- Price lists (Version October 2019 – For G2 use version August 2019)
- SERVOSoft (information in chapter 10.1. SERVOSoft)
- GETBER (for more information see chapter 10.2 GETBER)
- Presentation package with all product details will be revised in Q1 2020

The gradual introduction should be supported by the sales department as follows:

- All special components of the G2 will be blocked for re-disposition at the dates specified in chapter 2.1.
- All standard gearboxes can be selected in SAP for the dates listed under chapter 2.1.
- All orders and inquiries will be converted to G3 for the dates mentioned in chapter 2.1.

  Standard Gearboxes:

  The schedulers were provided by K&E with a list of all standard componentsG2 vs. G3. According to the dates mentioned under chapter 2.1, the schedulers keep the corresponding components under special observation and control the conversion.

  Special Gearboxes:

  These are not yet released for selection in SAP, therefore it is inevitably recognized by the OD when attempting the changeover that it is a special gear.

  In this case, the order is started as G2 in SAP.

  Since the special components are locked for re-planning, the dispatcher logs on to the OD if necessary. The OD starts a VC support ticket to switch from G2 to G3.

  VC Support creates the variant as G3 in SAP for selection and informs the OD and the responsible scheduler. The order can be started as G3 and the scheduler can schedule the G3 parts according to the history of the G2 parts.

  Conversion of customers with MVL (Amada, Trumpf) or special gearboxes running in larger numbers (Schuler, Hermle) can basically be treated in the same way. It makes sense, however, to coordinate the procedure between Area Sales Manager, OD, R&D, scheduler and, if necessary, SPG.

  Sample gearboxes for evaluation tests are possible approximately 5 months after the dates mentioned in chapter 2.1.

- For conversion, the OD creates an offer with the same discount or net price as the requested / ordered G2 Gearbox. This offer will be sent to the customer together with the following documents:
  - Customer information on the conversion of planetary gearboxes from Generation 2 to Generation 3
  - Attach the STEP file to the offer
- Comparison charts G2 vs. G3 for the offered series and size only on request from the Area Sales Manager. (For special gearboxes only if there is no restriction due to the special design, if necessary, consult SPG).

- C + D customers in Germany will be switched over to the dates listed under chapter 2.1 without separate consultation with the Area Sales Manager. The Area Sales Manager receives a copy of the changeover offer.

  Delivery dates at the earliest 1 month after the dates mentioned in chapter 2.1.

- A + B customers in Germany are actively approached by the sales force one month after the dates mentioned under chapter 2.1. If required and on request, the Area Sales Manager is actively supported by SPG.

  Delivery dates in coordination with OD and the schedulers.

  Goal conversion at the latest 4 months after the dates mentioned in chapter 2.1.

  For the conversion, the sales force has the documentation and tools listed in the Sales Release and Product Release Brief.

- As of 1st February 2020, active contact with customers abroad by the subsidiaries and trading companies.

  Goal conversion at the latest 10 months after the dates mentioned in chapter 2.1

  For the conversion, the subsidiaries and trading companies have the documentation and tools listed in the Sales Release and Product Release Brief.

## 3. Marketing

**Marketing – Rollout-Plan**

- Ads and press information from 01.10.2019 to press distribution list
- Advertisements in nine trade journals 07.11. - 26.11.2019
- To the SPS fair
  - G3 planetary gear is the center of attention as a trade fair highlight
  - Double-sided A4 flyer in DE and EN
  - Press Folder
  - Short foil set
- Marketing sales sheet set until the end of December 2019
- Detailed technical report to press distributor January 2020

**Kick Off Events**

- Kick Off Events from 01.10.2019 - Invitation to do so via the intranet
- 2x in Hanauer Straße with specialization for the order center (OD)
- 2x each in plant 4 and plant 1 for all interested parties (SAT staff)

## 4. Product Phase Out G2

- Due to the high compatibility of the successor generation as well as many proactive conversion activities, we have achieved a conversion rate of 66 % for incoming orders in the 4th quarter of 2020. At this point, we would like to thank everyone who has actively helped us achieve this.
  As we all have to learn by now, the parallel production of two gearbox generations has a negative impact on our delivery performance. The higher the conversion rate, the better the delivery performance for the G3 will be, but also the worse for the G2. Therefore we all need to continue to actively work on converting to G3 as quickly as possible.
- The Generation 2 gear units listed below will be discontinued on March 31, 2022. The discontinuation affects all gear units and geared motors according to the catalog as well as all special versions created on this basis.

  **P22 - P92, PA32 - PA82**
  **PH32 - PH82, PHA32 - PHA82**
  **PHQ42 - PHQ82, PHQA42 - PHQA82**

- Due to the fact that the number of pieces and therefore the lot sizes of the G2 had to be reduced considerably, the gross sales prices for the G2 have to be increased by 10 %. The price adjustment will take place on 1st August 2021.
- After the discontinuation, the gear units (catalog standard) can still be obtained from Service department for at least 5 years.
  This only applies if the G3 gear units cannot be used for technical or dimensional reasons. Special designs require separate agreements.

- The control of the components of Generation 2 which are replaced by new ones in Generation 3 is automatic. This is important for all customers who change over to Generation 3 at a late stadium. In order to avoid having to scrap too many components after the successful introduction of Generation 3, components will be controlled gradually. The components concerned are one-piece gearbox covers and couplings:

    - One-piece gearbox covers: As soon as one-piece gearbox covers of Generation 2 of one size are used up, the system automatically switches to the matching gearbox cover with motor plate. The customer does not receive any additional information on this. As soon as the customer switches to Generation 3, all one-piece adapters are available again. Please note that this change leads to an enlargement of the square dimension as described in chapter 7.3. In individual cases, an interference contour at the customer can be expected.
    - Couplings: The different coupling diameters are controlled according to the same principle. When the smallest shaft coupling is used up, the system automatically switches to the next larger coupling with a clamping bush. If the changeover process continues to be delayed, it is also possible that two coupling sizes will be skipped. This can happen after 9 months from a regulation specified by us.
      For the G3 sizes 3+4 which were introduced on October 1, 2019 this is possible from July 1, 2020. Here too, all coupling sizes are available again after a changeover to Generation 3.

# 5. Description

## 5.1 Product Lines

The planetary gear series P and PH(Q) were revised:

- P3 to P9 (not P2 - see below)
- PA3 to PA8 - no separate series anymore,
  - only option red. Backlash (applies to all A-series)
- PH(A)3 to PH(A)8
- PHQ(A)4 to PHQ(A)8

The following add-on parts are affected by the new uniform input-side interface for mounting to the planetary gearboxes:

- ME (L) (C) adapter
- MF (L) (C) adapter
- MB adapter
- A- side EZ motor
- A- side ED / EK motor
- Output K gearbox to P / PH(Q)
- Output KX gearbox to P / PH(Q)

Due to the SAT modular system, the series will be later

- KS
- PE
- PH(Q)9 - PHQ12

also revised.

P2 remains unchanged, but also gets the generation number 3.

This also contributes to an approx. 15% increase in the acceleration torque and the uniform configuration (including shock factor) with the new derating of 15%

Zh> = 1000 cycles / h.

## 5.2 Combinations

| | ME(L) | MF(L) | MEC MFC | MB | AW | EZ | EZ..W | ED/EK | KX | K |
|---|---|---|---|---|---|---|---|---|---|---|
| **P** | X | X | O | X | - | X[1)] | - | O | X[2)] | X |
| **PH** | X | X | O | X | - | X[1)] | - | O | X[2)] | X |
| **PHQ** | X | X | O | X | - | X[1)] | - | O | X[2)] | X |

X= Catalogue variant

O= no Catalogue variant, not for new projects. Existing customers can further place their orders

- = not combinable

[1)] Direct mounting can be combined with the same or a larger motor size. Two size jumps are no longer possible (for example P43 .. EZ7 ..)

[2)] KX8 will be replaced by KX7. Provide KX7 for attachment to P8.
Full torque on the P8 / PH(Q) 8 only possible with larger ratios.

At G3 we have standardized the interfaces. In this course, the pinion shafts of ratios i = 7, 8 and 10 have received an additional, larger shaft diameter. This circumstance makes it possible to combine larger motors with these ratios. In the table below, this is shown using the example of a single-stage gear unit size P5. For the other sizes, this is analogous. If these combinations do not appear in the catalog, this is due to the low load characteristic value. If you still need this combination, you can check it with Easy Drive and calculate the technical data.

| Übersetzung Ratio | Zapfen Ø Shaft Ø | | EZ501 Ø 11 + 14 | EZ502 Ø 11 +14 | EZ503 Ø 11 + 14 | EZ505 Ø 14 | EZ701 Ø 14 + 18 | EZ702 Ø 14 + 18 | EZ703 Ø 14 + 18 | EZ705 Ø 18 |
|---|---|---|---|---|---|---|---|---|---|---|
| | G2 | G3 | | | | | | | | |
| 3 | 14 / 18 | 14 / 18 | ● | ● | ● | ● | ● | ● | ● | ● |
| 4 | 14 / 18 | 14 / 18 | ● | ● | ● | ● | ● | ● | ● | ● |
| 5 | 14 / 18 | 14 / 18 | ● | ● | ● | ● | ● | ● | ● | ● |
| 7 | 14 | 14 / 18 | ● | ● | ● | ● | ● | ● | ● | ● |
| 8 | 14 | 14 / 18 | ● | ● | ● | ● | ● | ● | ● | ● |
| 10 | 14 | 14 / 18 | ● | ● | ● | ● | ● | ● | ● | ● |
| | | | ● | Grün/green G2 + G3 | | | ● | Rot nur/red only G3 | | |

## 5.3 Combinations - MB

Due to Mayr's design change at the ServoStop (motor adapter with integrated brake), there are still delays when switching to Generation 3 with MB.
Until further notice, only the G2 is available for applications with MB. However, there will be separate sales information on this topic.

## 5.4 New Possible Options

New shaft sealing option in the input:

Starting with size 5 (P/PH), generation 3 offers the option of using an MSS1-HS shaft seal in the input of the gearbox

standard

FKM shaft seal

optional

MSS1 HS shaft seal

Advantages are:

- Two sealing lips
- The supplier Freudenberg fills the gap with a defined quantity of grease
- Increased sealing safety
- High temperature resistance
- Very long lifetime and reliability

## 5.5 Type Code

| Gear Type | Size | Generation | Number of Stages | Housing Design | Shaft Design | Bearing Design | Backlash | Ratio Code | Input Option |
|---|---|---|---|---|---|---|---|---|---|
| P | 4 | 3 | 1 | S | G | S | S | 0050 | ME |
| PH(Q) | 4 | 3 | 1 | S | F | S | S | 0050 | ME |
| | | | | | | | | | |
| Variants: | | | | | | | | | |
| P | | | | S | G | S | S | | ME(L) |
| | | | | X | P | D | R | | MF(L) |
| | | | | | | Z | | | MB |
| PH(Q) | | | | S | F | S | S | | ME(L) |
| | | | | X | | V | R | | MF(L) |
| | | | | | | | | | MB |

Option

Change in the Type Code

Special

**Changes G3 vs. G2:**

- Gearbox type: Reduced backlash is only an option in G3. This can be seen from the type code - see above
- Size: no change
- Generation number: 3
- Number of steps: no change
- Housing design (new for PH(Q)): S ... standard
- X ... special housing, e.g. milled flange segment on PH(Q)
- Number of stages: no change
- Housing Design (new at PH(Q)):
  - P Line:
    - S ... standard deep groove ball bearing (was at G2 "R")
    - D ... double skew bearings (like G2)
    - Z ... cylindrical roller bearings (like G2)
  - PH (Q) transmissions:
    - S ... Standard PH (Q) 3-PH (Q) 5 Angular contact ball bearings - PH(Q)7 and PH(Q)8 Tapered roller bearings
    - V ... Reinforced storage. Only for PH(Q)3 - PH(Q)5 helical roller bearings
- Backlash - New at P and PH(Q). Replaces the A-series of the G2
  - S ... standard Backlash
  - R ... Reduced Backlash
- Ratio code: no change
- Motor Adapter:
  - ME .... EasyAdapt in G3 freely selectable for gearboxes with standard and red. Backlash
  - MF .... FlexiAdapt in G3 freely selectable for gearboxes with standard and red. Backlash
- PH9 & PH10 and PHQ9-PHQ12 retain their old typing code. You get the new generation and type code after revision

# 6. Technical Data

## 6.1 General information

The gearboxes of the G3 are equally good or better in all technical criteria. Due to more extensive and more precise calculation methods, slightly lower catalogue values have resulted in a few criteria. In other words, the catalogue data of the G2 could not all be verified with the current calculation methods...

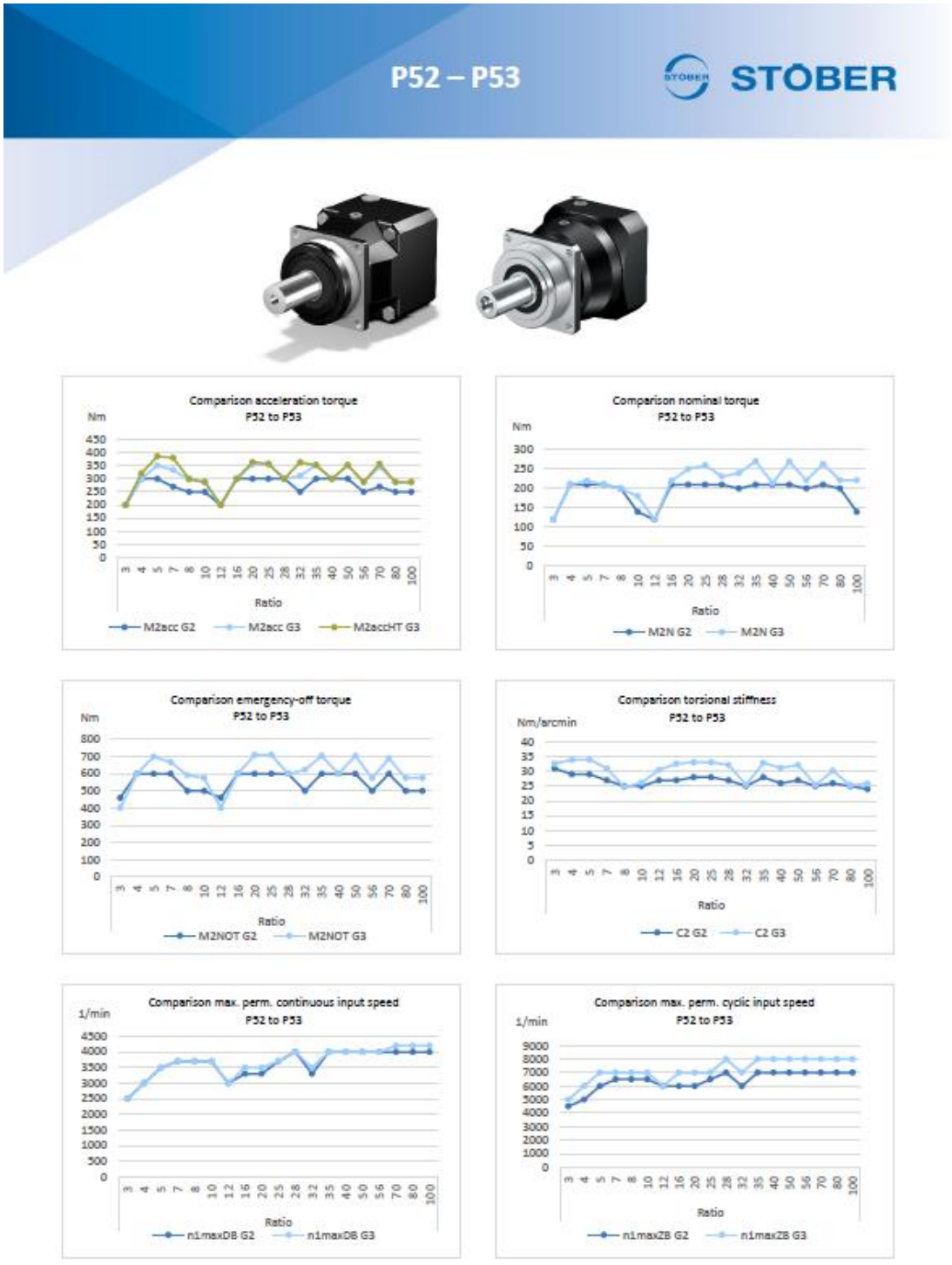
We have created very extensive comparison documents. These we provide you as described in Chapter 1:

- Comparison diagrams G2 vs. G3 per series and size
  (Example.: „Vergleiche P5 G2-G3_Diagramme_EN“)
  - Acceleration torques
  - Nominal torques
  - Emergency stop torques
  - Continuous operating speeds
  - Cycle operating speeds
  - Torsional stiffness
- Comparative presentation „Planetary Gear Units G3 vs G2_EN.pptx“

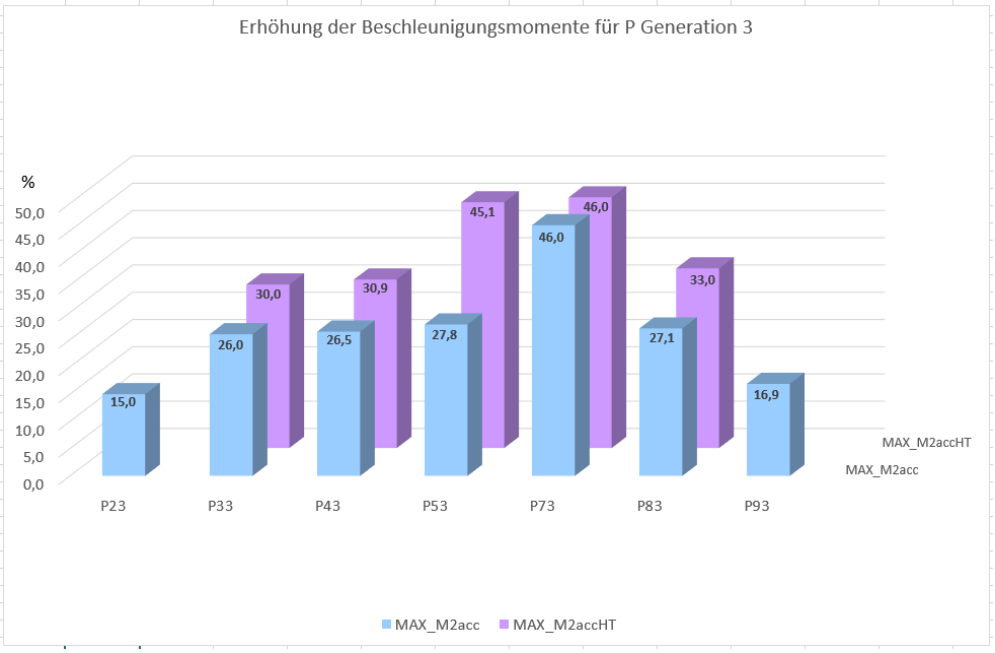
Competitive comparisons with the products of the most important competitors are in preparation. These will be made available to you later.

## 6.2 Torques, speeds and torsional stiffness

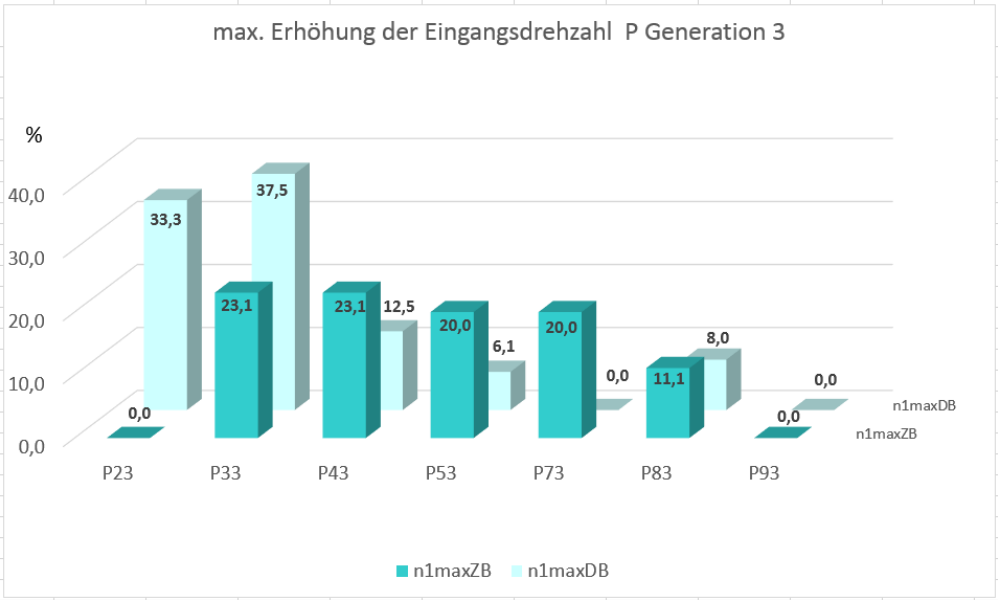
As already shown in chapter 5.1, the comparisons G2 to G3 are available in different formats. The quick comparison as comparison diagram per series and size as PDF is shown below using the example of P5.



In the comparison presentation are all relevant improvements and modifications are shown. In the comparative presentation, we decided to use bar charts for an entire series for each criterion. Here is an example of the acceleration torques of the P series. The diagram shows that the acceleration torques could be increased by up to 46% with standard backlash and reduced backlash.




A further example shows the increase in speeds of the P-gearbox $n_{1maxZB}$ by up to 23.1 % and $n_{1maxDB}$ by up to 37.5 %



## 6.3 Bearing

- Series P:

The proven output shaft bearings of the P series have been taken over into the new Generation 3 series. This allows our customers to continue to benefit from the advantages of optimization to meet their specific requirements in the future. The associated low friction increases the efficiency and reduces the heat loss.

The radially reinforced bearing "Z" (cylindrical roller bearing) is still available for timing belt applications with high radial forces. With its high load carrying capacity, this bearing arrangement offers sufficient reserves even if the belt preload is not defined but adjusted according to individual sensitivities.

The option "D" (double angular contact bearing) provides a backlash-free bearing arrangement with high radial and axial load carrying capacity. This bearing arrangement is particularly suitable when high loads occur simultaneously in the radial and axial directions, e.g. in the case of helical gear rack drives. For pure axial loads, the values could be increased by up to 150%.

| **Baugröße** ***Size*** | **Axialkräfte für D-Lager G2 [N]** ***Axial Force Bearing Option D G2 [N]*** | **Axialkräfte für D-Lager G3 [N]** ***Axial Force Bearing Option D G3 [N]*** |
|---|---|---|
| P3 | 1.400 | 2.500 |
| P4 | 2.250 | 4.000 |
| P5 | 3.500 | 6.000 |
| P7 | 4.500 | 10.000 |
| P8 | 7.500 | 15.500 |
| P9 | 10.000 | 25.000 |

Another advantage of the double angular contact bearing is the good concentricity, for this option you will find concentricity tolerances in the dimension drawings.

For size 7, slightly larger bearings could be provided. This is reflected in slightly higher permissible values, or the service life increases with the same loads.

- Series PH(Q):

In the PH(Q) series, the proven angular contact bearings from the G2 have been taken over.

Sizes PH3-PH(Q)4-PH(Q)5 are angular contact ball bearings, PH(Q)7 and PH(Q)8 are tapered roller bearings. These are arranged on both sides of the planetary gearing and preloaded in the so-called O-arrangement.

The pretensioning takes place in the G3 over of a threaded ring. This has the advantage that the preload is stepless and precisely adjusted to the desired value. The result is a constant quality of the bearing preload and thus of the tilting rigidity.

Optionally, we now offer a reinforced bearing arrangement "V" in the G3 for sizes PH3-PH(Q)4-PH(Q)5.
The angular contact ball bearings are replaced by more stable angular contact roller bearings.

**Allowed Output Shaft Loads Standard Bearing S**

| Typ | $z_2$ [mm] | $F_{2ax100}$ [N] | $F_{2rad100}$ [N] | $F_{2rad,acc}$ [N] | $M_{2k100}$ [Nm] | $M_{2k,acc}$ [Nm] | $C_{2k}$ [Nm/ arcmin] |
|---|---|---|---|---|---|---|---|
| PH3 | 62,5 | 1650 | 1613 | 1613 | 101 | 101 | 53 |
| PH4 | 83,0 | 2150 | 3095 | 3571 | 257 | 296 | 160 |
| PH5 | 97,0 | 4150 | 4536 | 4897 | 440 | 475 | 380 |

**Allowed Output Shaft Loads Reinforced Bearing V**

| Typ | $z_2$ [mm] | $F_{2ax100}$ [N] | $F_{2rad100}$ [N] | $F_{2rad,acc}$ [N] | $M_{2k100}$ [Nm] | $M_{2k,acc}$ [Nm] | $C_{2k}$ [Nm/ arcmin] |
|---|---|---|---|---|---|---|---|
| PH3 | 66,5 | 2200 | 2250 | 2250 | 150 | 150 | 53 |
| PH4 | 88,5 | 2900 | 4000 | 4000 | 354 | 354 | 160 |
| PH5 | 104,0 | 5000 | 5500 | 5500 | 572 | 572 | 380 |

Increase in shaft load axial up to 34.9 % and radial up to 39.5 % or up to 3 times longer service life for the same load, but also slightly higher system friction.

## 6.4 Shaft load

The permissible shaft loads for P gearboxes G2 and G3 are identical, as the same bearings are used. However, there is a "reduction" of the values for the tilting moment, since dimension z2 has been slightly shortened. The lower tilting moments result with the same force application point (x2) due to the changed lever ratios.

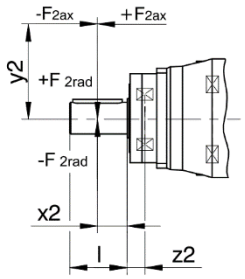
| Typ | Z2 | $F_{2ax100}$ | $F_{2rad100}$ | $F_{2rad,acc}$ | $M_{2k100}$ | $M_{2k,acc}$ |
|---|---|---|---|---|---|---|
| | [mm] | [N] | [N] | [N] | [Nm] | [Nm] |
| P521 (R-Lagerung) | 23,0 | 2300 | 6500 | 7000 | 338 | 364 |
| P531 (S-Lagerung) | 19,5 | 2300 | 6500 | 7000 | 315 | 340 |

**Calculation of the tilting moment using the example of a P5**

Shaft length P5 = 58mm → force application point (x2) at shaft centre = **29mm**

**P521:**
F2rad100 * ((X2 + Z2)/1000)) = M2k
6500N*((29mm + 23mm)/1000) = 338Nm

**P531:**
F2rad100 * ((X2 + Z2)/1000)) = M2k
6500N*((29mm + 19,5mm)/1000) = 315Nm

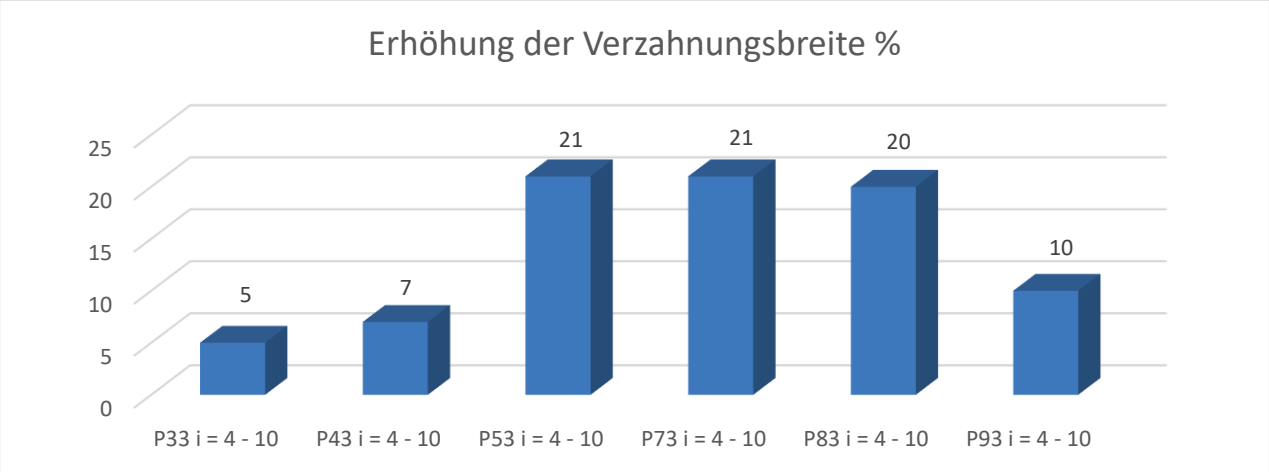


## 6.5 Toothing

The toothing forms the heart of a gearbox. STÖBER has been developing and producing gearboxes for over 70 years. Through continuous innovative technological developments and investments in the most modern production facilities, we are today represented in the technological top field. In the development of Generation 3 planetary gearheads, we were once again able to contribute this high level and develop a product that sets new standards.

**Optimized toothing width:**

- In the current generation, the gear teeth of the next smaller size are used for 2-stage gearboxes in the input. This gearing is oversized. Generation 3 has been converted to a new narrower gearing optimised to the required torque in order to optimise the overall length.
- The toothing width was increased for the gear ratios i = 4 - 10 in the gear teeth of the output stage. The diagram below shows the percentage increase in the toothing width.




Percentage increase in toothing width in generation 3

In the i=3 ratio, the increase in the toothing width was dispensed with in favour of lower churning losses. With i=3 in the planetary system, the planets rotate approx. 1.4 times faster than the sun wheel (the motor). The churning losses in gears increase with the speed and with the toothing width. Gear ratio i=3 is primarily used for applications with high speeds. The torques are already so high without increasing the toothing width, that common servo motors cannot achieve this.

**Gear materials, hardening processes, quality and machining:**

For the planetary and sun gears, state-of-the-art materials and case hardening processes were used. The finishing of these gears is carried out with high-end gear grinding machines of the most notable manufacturers in highest quality. The quality class of these gear parts could thus be increased by 1 - 2 classes.

A new toothing process, power skiving (hob peeling), is used to produce the hollow gear teeth. With this process, the hollow gear teeth can be produced in one clamping with the bearing seats and in significantly higher quality (1 - 2 classes). Complete machining on one machine avoids reclamping errors and the component does not have to be re-aligned. This eliminates concentricity errors.

In power skiving, the speeds of the workpiece and tool are synchronized. The superimposed feed movement peels the gaps between the teeth out of the housing material from the cutting edge of the tool.

Video on the new manufacturing process 

The hollow gear teeth are machined directly into the housings. The P series uses high-strength nodular graphite cast iron (GGG70) with a minimum tensile strength of 700N/mm².

The PH(Q) series uses a high-strength tempering steel (31CrMoV9 with 1000N/mm²).

**Series P with reduced backlash:**

To achieve low backlash, the tolerances of the gearing parts are narrowed. In other words, the gear parts are manufactured in an even higher quality class than the standard. In addition to the low backlash, the higher quality also has an effect on the permissible acceleration torque. Increases of up to 16% compared to the standard backlash could be achieved.

Since the reduced backlash can be selected as an option in the G3, two values for the acceleration torque are shown in the selection tables.

$M_{2acc}$ is the value for the standard rotary backlash

$M_{2accHT}$ is the value for the reduced rotary backlash

| $C_2$ [Nm/arcmin] | $L_{pA}$ [dB(A)] | $M_{2N}$ [Nm] | $M_{2acc}$ [Nm] | $M_{2accHT}$ [Nm] | $M_{2NOT}$ [Nm] |
|---|---|---|---|---|---|
| 64 | 59 | 540 | 770 | 805 | 1540 |
| 63 | 57 | 454 | 700 | 700 | 1400 |
| 63 | 57 | 454 | 700 | 700 | 1400 |
| 63 | 57 | 565 | 770 | 805 | 1540 |
| 63 | 57 | 565 | 770 | 805 | 1540 |

**Series PH(Q) with reduced backlash - nitrided hollow gear teeth:**

In conjunction with the "reduced backlash" option, the housings of the PH(Q) output stage are nitrided. In cooperation with the FZG (Forschungsstelle für Zahnräder und Getriebebau) at the Technical University of Munich, significantly higher material parameters for the gear tooth calculation could be applied for the hollow gear tooth hardened in this way, and thus significantly higher torque values ($M_{2accHT}$) could be achieved. The option "reduced torsional backlash" can therefore also be used in future if the acceleration torque of the "standard version" is no longer sufficient. Increases of up to 39% could be achieved compared to standard backlash.

| $C_2$ [Nm/arcmin] | $L_{pA}$ [dB(A)] | $M_{2N}$ [Nm] | $M_{2acc}$ [Nm] | $M_{2accHT}$ [Nm] | $M_{2NOT}$ [Nm] |
|---|---|---|---|---|---|
| | | | | | |
| 338 | 59 | 850 | 1392 | 1392 | 2784 |
| 341 | 59 | 850 | 1392 | 1392 | 2784 |
| | | | | | |
| 490 | 63 | 1100 | 2000 | 2200 | 4000 |
| 494 | 63 | 1100 | 2000 | 2200 | 4000 |
| 518 | 63 | 1250 | 2100 | 2300 | 4200 |
| 521 | 63 | 1250 | 2100 | 2300 | 4200 |

By all these measures the torques of the G3 could be increased by up to 60% - details see comparisons G2 - G3.

# 7. Geometry Data

**The mechanical interfaces on the output are almost 100% compatible with the G2.**

Except for the P2, all G3 transmissions have become significantly shorter. With frame size P2, no reduction in the overall length could be implemented.
Thus, collisions with the machine contour cannot be expected

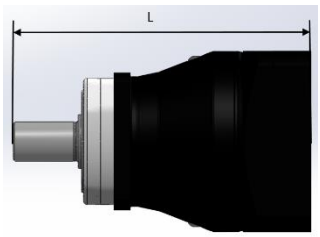
However, in general we recommend an interference contour check based on the new 3D- solid models.
You receive this

- together with the offer of our order center
- by configuring your product with the STÖBER Configurator

https://configurator.stoeber.de/de-DE/?shop=SAT

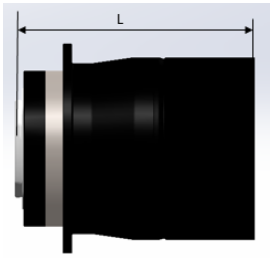
## 7.1 Overall length

- P-unit




| | G2 ME L [mm] | G3 ME L [mm] | Reducing [mm] | G2 MEL L [mm] | G3 MEL L [mm] | Reducing [mm] |
|---|---|---|---|---|---|---|
| P221 - P231 | 109,5 | 109,5 | 0,0 | 129,0 | 129,0 | 0,0 |
| P222 - P232 | 141,5 | 141,5 | 0,0 | 161,0 | 161,0 | 0,0 |
| P321 - P331 | 153,0 | 145,5 | 7,5 | 159,3 | 147,0 | 12,3 |
| P322 - P332 | 173,5 | 163,0 | 10,5 | 193,0 | 182,5 | 10,5 |
| P421 - P431 | 174,0 | 165,5 | 8,5 | 185,5 | 178,5 | 7,0 |
| P422 - P432 | 218,5 | 202,5 | 16,0 | 224,8 | 204,0 | 20,8 |
| P521 - P531 | 217,0 | 210,5 | 6,5 | 233,0 | 223,0 | 10,0 |
| P522 - P532 | 263,5 | 239,5 | 24,0 | 275,0 | 252,5 | 22,5 |
| P721 - P731 | 268,0 | 264,5 | 3,5 | 293,0 | 287,5 | 5,5 |
| P722 - P732 | 318,0 | 302,5 | 15,5 | 334,0 | 315,0 | 19,0 |
| P821 - P831 | 318,0 | 311,5 | 6,5 | 334,0 | 320,5 | 13,5 |
| P822 - P832 | 376,5 | 356,5 | 20,0 | 401,5 | 379,5 | 22,0 |
| P921 - P931 | 396,0 | 380,5 | 15,5 | - | - | - |
| P922 - P932 | 476,0 | 463,5 | 12,5 | 492,0 | 472,5 | 19,5 |

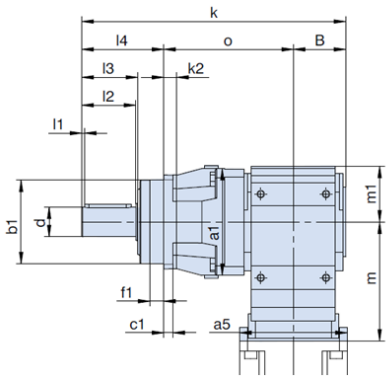
- PH(Q)-unit



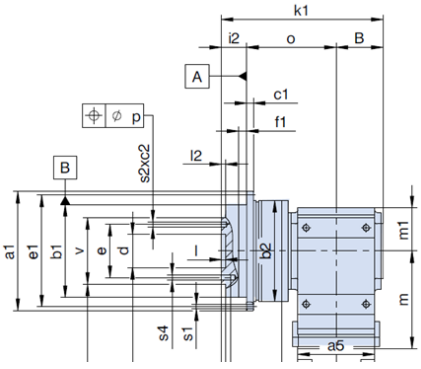

| | G2 ME L [mm] | G3 ME L [mm] | Reducing [mm] | G2 MEL L [mm] | G3 MEL L [mm] | Reducing [mm] |
|---|---|---|---|---|---|---|
| PH321 - PH331 | 102,5 | 98,5 | 4,0 | 108,8 | 100,0 | 8,8 |
| PH322 - PH332 | 119,0 | 116,0 | 3,0 | 138,5 | 135,5 | 3,0 |
| PH(Q)421 – PH(Q)431 | 120,0 | 113,5 | 6,5 | 131,5 | 126,5 | 5,0 |
| PH(Q)422 – PH(Q)432 | 164,5 | 150,5 | 14,0 | 170,8 | 152,0 | 18,8 |
| PH(Q)521 – PH(Q)531 | 134,0 | 132,0 | 2,0 | 150,0 | 144,5 | 5,5 |
| PH(Q)522 – PH(Q)532 | 180,5 | 161,0 | 19,5 | 192,0 | 174,0 | 18,0 |
| PH(Q)721 – PH(Q)731 | 164,0 | 161,0 | 3,0 | 189,5 | 184,0 | 5,5 |
| PH(Q)722 – PH(Q)732 | 214,0 | 199,0 | 15,0 | 230,0 | 211,5 | 18,5 |
| PH(Q)821 – PH(Q)831 | 218,0 | 218,0 | 0,0 | 234,0 | 236,0 | -2,0 |
| PH(Q)822 – PH(Q)832 | 277,0 | 263,0 | 14,0 | 303,0 | 286,0 | 17,0 |

- Combination – Gear units

P53K1 - P93K4

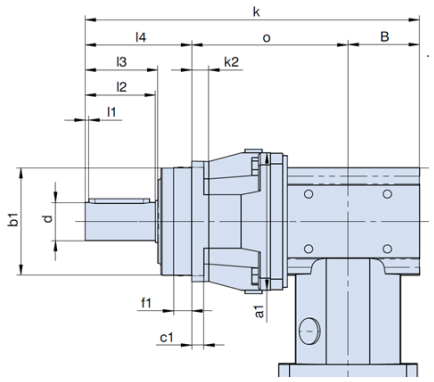



PH53K1 - PH83K3



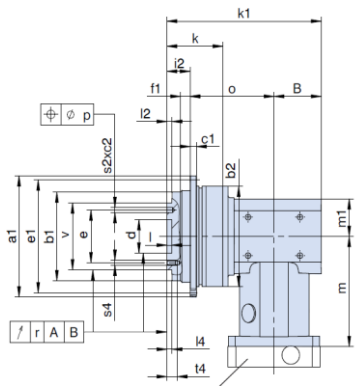

| G2 | | Measure "O" | G3 | Measure "O" | Diff. | | G2 | | Measure "O" | G3 | Measure "O" | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| K1 | P521 | 139 | P531 | 143,5 | 4,5 | | K1 | PH521 | 116 | PH531 | 124 | 8,0 |
| K1 | P721 | 150 | P731 | 156,5 | 6,5 | | K1 | PH721 | 120 | PH731 | 127 | 7,0 |
| K2 | P721 | 164 | P731 | 170,5 | 6,5 | | K2 | PH721 | 134 | PH731 | 141 | 7,0 |
| K2 | P821 | 202,5 | P831 | 207,5 | 5,0 | | K2 | PH821 | 164,5 | PH831 | 176 | 11,5 |
| K3 | P821 | 210 | P831 | 215 | 5,0 | | K3 | PH821 | 172 | PH831 | 183,5 | 11,5 |
| K4 | P921 | 257,5 | P931 | 260,5 | 3,0 | | | | | | | |

P53KX3 - P83KX8




| | G2 | Measure "O" | G3 | Measure "O" | Diff. | | | G2 | Measure "O" | G3 | Measure "O" | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KX3 | P321 | 96 | P331 | 91 | -5,0 | | KX3 | P322 | 136 | P332 | 125,5 | -10,5 |
| KX4 | P421 | 115 | P431 | 115 | 0,0 | | KX3 | P422 | 153,5 | P432 | 140 | -13,5 |
| KX5 | P521 | 129 | P531 | 128,5 | -0,5 | | KX4 | P522 | 172,5 | P532 | 157 | -15,5 |
| KX7 | P721 | 157 | P731 | 158,5 | 1,5 | | KX5 | P722 | 206 | P732 | 196,5 | -9,5 |
| KX7 | | | P831 | 193 | neu | | KX7 | P822 | 265,5 | P832 | 250,5 | -15,0 |
| KX8 | P821 | 213 | | | | | KX8 | P922 | 340 | P932 | | |

PH53KX3 - PH83KX8



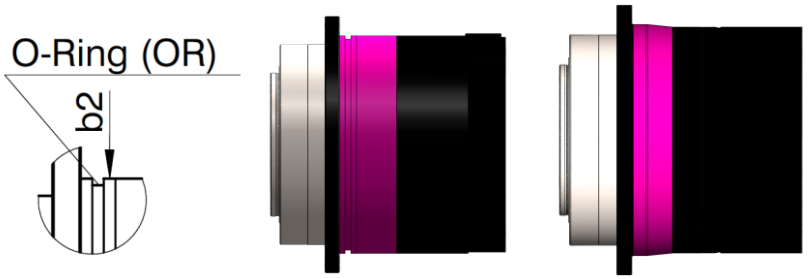

| | G2 | Measure "O" | G3 | Measure "O" | Diff. | | | G2 | Measure "O" | G3 | Measure "O" | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KX3 | PH321 | 74 | PH331 | 71,5 | -2,5 | | KX3 | PH322 | 110 | PH332 | 107 | -3,0 |
| KX4 | PH421 | 87 | PH431 | 85,5 | -1,5 | | KX3 | PH422 | 125,5 | PH432 | 114 | -11,5 |
| KX5 | PH521 | 105 | PH531 | 109 | 4,0 | | KX4 | PH522 | 148,5 | PH532 | 137,5 | -11,0 |
| KX7 | PH721 | 127 | PH731 | 127 | 0,0 | | KX5 | PH722 | 176 | PH732 | 167 | -9,0 |
| KX7 | | | PH831 | 161,5 | neu | | KX7 | PH822 | 228 | PH832 | 219 | -9,0 |
| KX8 | PH821 | 175,5 | | | | | | | | | | |

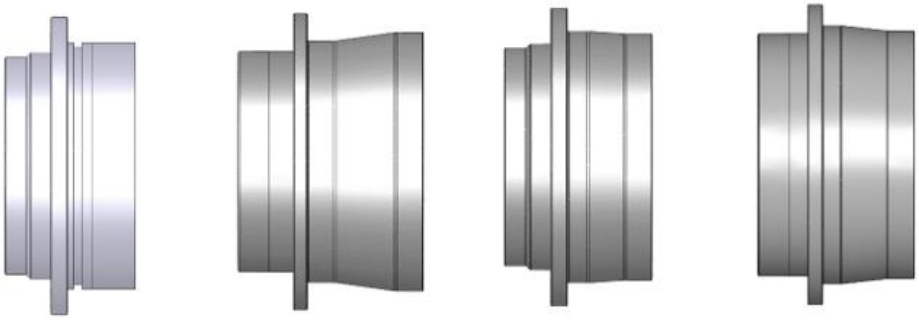
## 7.2 Interface at the output

- Important change in the P gearboxes: In order to transmit the increased torques, screws of strength class 12.9, like we already use for PH- gearboxes in Generation 2, must now be also used for attachment to the customer's construction.
  Applications in which the torques of the G2 (changeover) are not exceeded, can still be screwed with screws of strength class 10.9.
- **The mechanical interfaces on the output are almost 100% compatible with the G2**.
  For the PH(Q) series, there are 3 small deviations in the compatibility regarding the interface to the mounting construction:

**Deviation 1:**

For PH (Q) gearboxes, the second centering diameter b2 on the housing is omitted.



Size 3-8 Size 3-4 Size 5-7 Size 8

PH Generation 2 PH Generation 3

By changing the design of the planetary gearboxes and standardizing the motor adapters (used with P and PH (Q)), all motor adapters are now screwed to the gears from the backside.

For some sizes, this change meant that the housing diameter had to be increased (see table: changing the housing diameter). Due to this, it was no longer possible to offer the centering diameter b2.

Note: Only about 0.5% of our customers use the centering diameter b2.
See attached file „Customers_b2_2017-08.2018.xlsx“.
These customers should be informed early by the field service staff and so they have enough of time to change the machine design.

| | G2<br>max Ø [mm] | G3<br>max Ø [mm] | G3<br>After b2 change | Δ<br>[mm] |
|---|---|---|---|---|
| PH(Q)3 | 70,0 | 75,0 | | 5,0 |
| PH(Q)4 | 95,0 | 100,0 | | 5,0 |
| PH(Q)5 | 120,0 | 122,5 | - | 2,5 |
| PH(Q)7 | 152,0 | 153,5 | - | 1,5 |
| PH(Q)8 | 212,0 | 212,5 | 212h8* | 0,0 |

Table: change housing diameter
* Standard backlash

**Exception:**

For sizes 5-8 in two-stage version, it is possible to use the b2 diameter. This must be requested via a ROAD.

It is important to consider the size of the motor adapter. If necessary, use a two-part adapter where the plate is mounted after the gearbox has been installed.

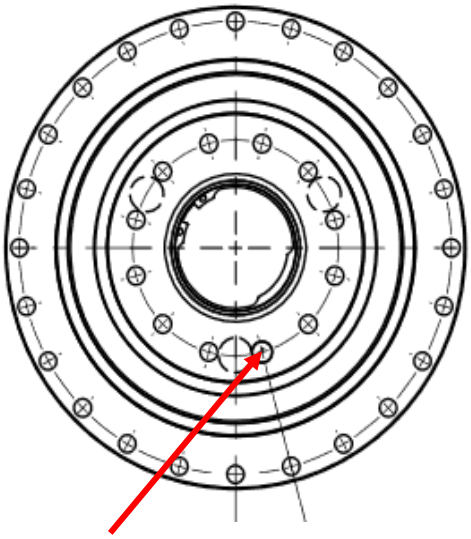
The first version already available is the P832 in the standard backlash version, see above in the table. For reduced backlash, a ROAD must still be provided.

The tolerance of the b2 diameter has also changed to h8.

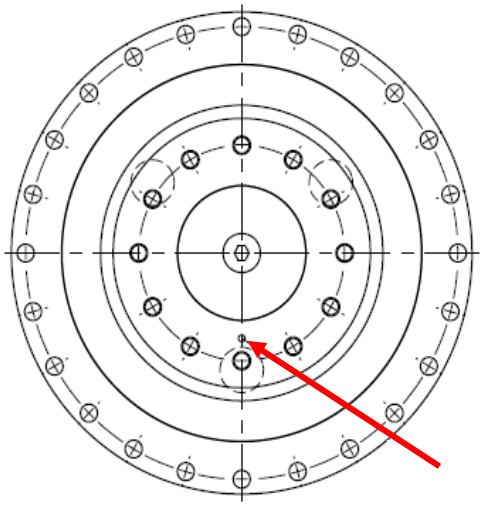
**Deviation 2:**

In the case of PH (Q) gears, the fixing bore s2 in the flange shaft (planet carrier) is replaced by a thread. The additional thread increases the transmittable torque of the screw joint. Since the fixing bore was used as a positional orientation of the planetary wheels in reversing operation, all G3 PH (Q) transmissions now receive a marking in the form of a small bore

Do you need the fixing hole? You can simply drill one of the threads down to the specified thread depth.
Example: For the PH5 we have M6x11 threads deep, in this case drill with Ø8H7 max. 11mm deep, for a cylindrical pin Ø8m6. We recommend drilling and rubbing together with your attached component.



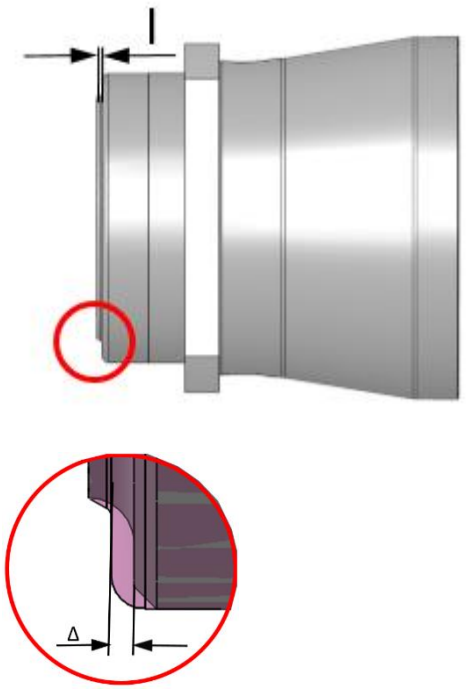
G2: Example with fixing bore S2



G3: without fixing bore but with additional thread and mark in order to define the position of the planetary wheels

**Deviation 3:**

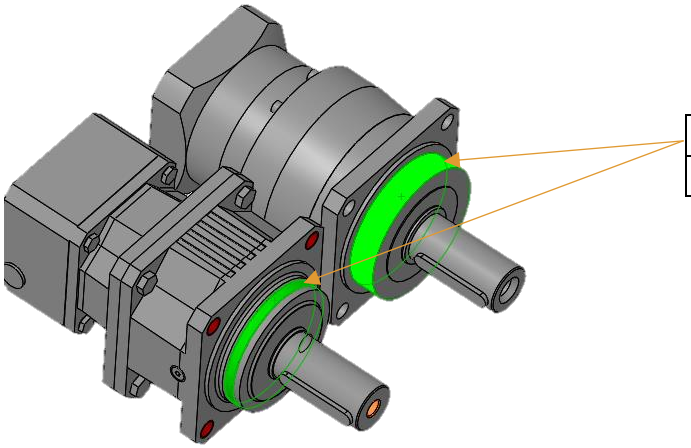
In the case of the P gear units, the dimension l, which is not specified in the catalog, has been reduced somewhat by the change of the tooth width (possibly interference contour).




| | G2<br>l [mm] | G3<br>l [mm] | Δ l<br>l [mm] |
|---|---|---|---|
| P3 | 2 | 1 | -1 |
| P4 | 2 | 1 | -1 |
| P5 | 2,5 | 1 | -1,5 |
| P7 | 2,5 | 1 | -1,5 |
| P8 | 4 | 1 | -3 |
| P9 | 5 | 2 | -3 |

**Deviation 4:**

A stronger output bearing has been installed in the new generation of size 7. As a result the permissible forces on the output shaft can be increased. This bearing, but also requires more space, which is why the diameter, which is not dimensioned in the catalogue, increases as follows. The pilot diameter is not affected. We recommend checking the CAD model.

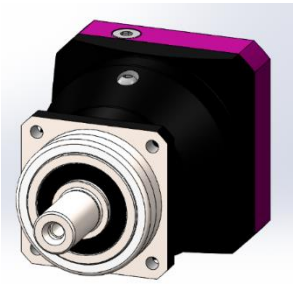


| Generation 2 | Generation 3 |
|---|---|
| Ø 107mm | Ø 115mm |

## 7.3 Interface at the input

By changing the design of the planetary gearboxes and standardizing the motor adapters (ME and MF at P and PH (Q)), all motor adapters are now screwed to the gearboxes from the backside. This change led to the fact that the housing diameter, and thus the square size of the motor adapter, had to be increased for some sizes (see table: Enlargement Square Size Motor Adapter)

| Type / Size | Motor shaft $d_{max}$ x $l_{max}$ [mm] | Square dimension G2 [mm] | Square dimension G3 [mm] |
|---|---|---|---|
| P231/P232/P332 / PH(Q)332 | 14x30 | 55 | 55 |
| P331/P432 / PH331/PH(Q)432 | 19x40 | 75 | 75 |
| P431/P532 / PH(Q)431/PH(Q)532 | 24x42 | 98/100 | 100 |
| P531/P732 / PH(Q)531/PH(Q)732 | 32x50 | 115 | **120** |
| P731/P832 / PH(Q)731/PH(Q)832 | 38x61 | 145 | **150** |
| P831/P932 / PH(Q)831 | 48x80 | 190 | **204** |
| P931 | 60x85 | 225 | **230** |

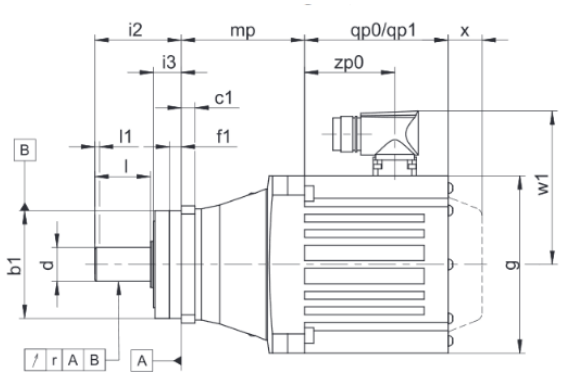


If there is an interfering contour when changing to a G3 plate, G2 plates are still available in special cases. In exceptional cases, these plates can be released for ordering.
In the medium term, you should ensure that the customer changes his design so that the new G3 plates fit.
Otherwise, the customer will only be able to get the G2 plate as a special plate at an extra charge in the future.

## 7.4 Direct mounting

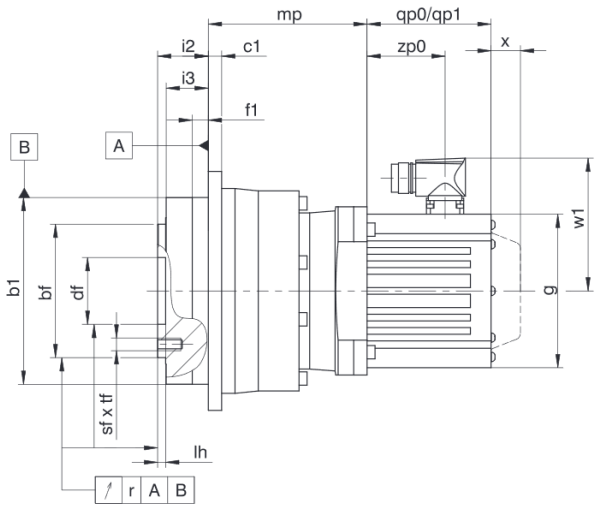
For information on which synchronous servomotors can be combined with which gearbox, please refer to chapter 4.2 Combinatorics or the Variant Generator.
Before the publication of the catalog (info in chapter 8) we would like to point out two dimensional changes.

- Reducing of the overall length (P-unit)




| | i2+mp | | Reduction |
|---|---|---|---|
| | G2 | G3 | [mm] |
| P221 - P231 EZ3 | 97,5 | 97,5 | **0,0** |
| P222 - P232 EZ3 | 129,5 | 129,5 | **0,0** |
| P321 - P331 EZ3 | 121,5 | 116,5 | **-5,0** |
| P321 - P331 EZ4 | 118,0 | 113,0 | **-5,0** |
| P322 - P332 EZ3 | 161,5 | 151,0 | **-10,5** |
| P421 - P431 EZ4 | 135,0 | 136,5 | **1,5** |
| P421 - P431 EZ5 | 137,5 | 136,0 | **-1,5** |
| P422 - P432 EZ3 | 187,0 | 173,5 | **-13,5** |
| P422 - P432 EZ4 | 183,5 | 170,0 | **-13,5** |
| P521 - P531 EZ5 | 169,0 | 168,5 | **-0,5** |
| P521 - P531 EZ7 | 175,0 | 171,5 | **-3,5** |
| P522 - P532 EZ4 | 224,5 | 210,5 | **-14,0** |
| P522 - P532 EZ5 | 227,0 | 210,0 | **-17,0** |
| P721 - P731 EZ7 | 210,0 | 212,5 | **2,5** |
| P721 - P731 EZ8 | 225,0 | 222,5 | **-2,5** |
| P722 - P732 EZ5 | 270,0 | 260,5 | **-9,5** |
| P722 - P732 EZ7 | 276,0 | 263,5 | **-12,5** |
| P821 - P831 EZ8 | 249,0 | 253,5 | **4,5** |
| P822 - P832 EZ7 | 318,5 | 304,5 | **-14,0** |
| P822 - P832 EZ8 | 333,5 | 314,5 | **-19,0** |
| P922 - P932 EZ8 | 407,0 | 405,5 | **-1,5** |

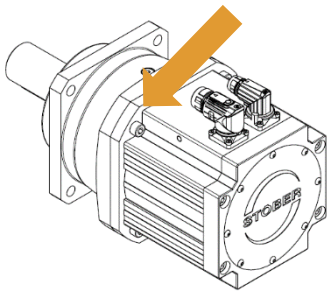
- Reducing of the overall length (PH(Q)-unit)

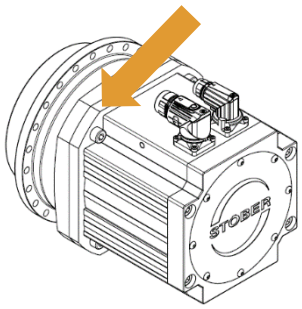



| | i2+mp | | Reduction |
|---|---|---|---|
| | G2 | G3 | [mm] |
| PH321 - PH331 EZ3 | 70,5 | 70,5 | **0,0** |
| PH321 - PH331 EZ4 | 67,5 | 67,0 | **-0,5** |
| PH322 - PH332 EZ3 | 107,0 | 104,0 | **-3,0** |
| PH(Q)421 - PH(Q)431 EZ4 | 81,0 | 84,5 | **3,5** |
| PH(Q)421 - PH(Q)431 EZ5 | 83,5 | 84,0 | **0,5** |
| PH(Q)422 - PH(Q)432 EZ3 | 133,0 | 129,0 | **-4,0** |
| PH(Q)422 - PH(Q)432 EZ4 | 129,5 | 125,5 | **-4,0** |
| PH(Q)521 - PH(Q)531 EZ5 | 86,0 | 91,0 | **5,0** |
| PH(Q)521 - PH(Q)531 EZ7 | 92,0 | 93,0 | **1,0** |
| PH(Q)522 - PH(Q)532 EZ4 | 141,5 | 133,0 | **-8,5** |
| PH(Q)522 - PH(Q)532 EZ5 | 144,0 | 132,5 | **-11,5** |
| PH(Q)721 - PH(Q)731 EZ7 | 106,0 | 109,0 | **3,0** |
| PH(Q)721 - PH(Q)731 EZ8 | 115,0 | 119,0 | **4,0** |
| PH(Q)722 - PH(Q)732 EZ5 | 166,0 | 157,0 | **-9,0** |
| PH(Q)722 - PH(Q)732 EZ7 | 172,0 | 160,0 | **-12,0** |
| PH(Q)821 - PH(Q)831 EZ8 | 149,5 | 160,0 | **10,5** |
| PH(Q)822 - PH(Q)832 EZ7 | 219,0 | 211,0 | **-8,0** |
| PH(Q)822 - PH(Q)832 EZ8 | 234,0 | 221,0 | **-13,0** |

- Change of the square flange

| Gear Unit Size G2 /G3 | Square dimension direct mounting | | | | Square dimension direct mounting | | |
|---|---|---|---|---|---|---|---|
| | [mm] G2 | [mm] G3 | Δ | Motor | [mm] G2 | [mm] G3 | Motor |
| P322/P332 | 72 | 72 | 0 | EZ3 | | | |
| P321/P331 | 72 | 72 | 0 | EZ3 | 98 | 98 | EZ4 |
| P422/P432 | 72 | 72 | 0 | EZ3 | 98 | 98 | EZ4 |
| P421/P431 | 98 | 98 | 0 | EZ4 | 115 | 115 | EZ5 |
| P522/P532 | 98 | 107 | 9 | EZ4 | 115 | 115 | EZ5 |
| P521/P531 | 115 | 115 | 0 | EZ5 | 145 | 145 | EZ7 |
| P722/P732 | 115 | 126 | 11 | EZ5 | 145 | 145 | EZ7 |
| P721/P731 | 145 | 158 | 13 | EZ7 | 190 | 190 | EZ8 |
| P822/P832 | 145 | 158 | 13 | EZ7 | 190 | 190 | EZ8 |
| P821/P831 | 190 | 214 | 24 | EZ8 | | | |
| P922/P932 | 190 | 214 | 24 | EZ8 | | | |
| PH321/PH331 | 72 | 72 | 0 | EZ3 | 98 | 98 | EZ4 |
| PH421/PH431 | 98 | 107 | 9 | EZ4 | | | |
| PH521/PH531 | 115 | 126 | 11 | EZ5 | | | |
| PH721/PH731 | 145 | 158 | 13 | EZ7 | | | |
| PH821/PH831 | 190 | 214 | 24 | EZ8 | | | |

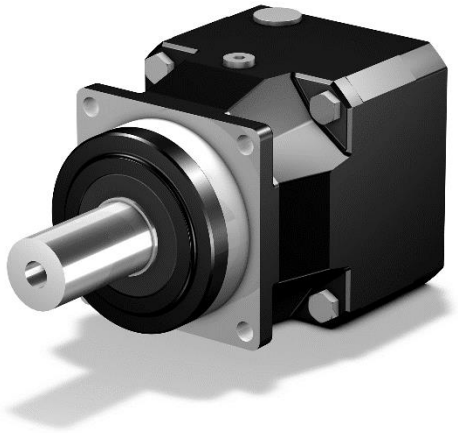




The 2-stage dimensions for PH gearboxes can be found on the P-gears. Regardless of whether it's a P or PH gearbox, the second stage is the same.
For further information, please refer to the Synchronous Servomotors Catalog and the STÖBER Configurator.

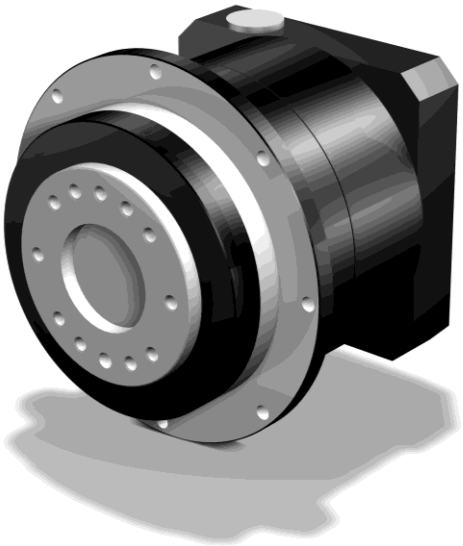
## 7.5 Optical Design

During the development of Generation 3, special attention was paid to the visual design. The housing components were designed that the outer contour can be completely reworked mechanically. This makes the dimensions more exact and the surface structure much smoother. The locking screws were sunk and plastic plugs in the motor connection flange were also replaced by a countersunk screw plug.
Due to these measures, the gearboxes have received a high-quality optical design that fits perfectly with the internal values of the gearbox.



Generation 2

Generation 3 (Exception P2, unchanged design)



## 7.6 Motor adapter - Couplings

The couplings ME and MF can be freely combined with the G3. This means that backlash-reduced Gear Units P / PH (Q) can also be offered in the future with the more cost-effective ME-adapter. This makes sense especially when it's a price-sensitive application in which the minimum positional deviation, resulting from a linear expansion of the motor shaft in combination with helical gearing of the gearbox is negligible. This has no influence on the actual backlash of the gearbox.
The MF adapter also makes sense in some cases in combination with a standard backlash, since there are individual third-party motors in which the manufacturer allows only a low or no axial forces. For these cases, an MF adapter should be used because then the axial forces will be absorbed via the bellows coupling.

# 8. Pricing

The top priority development goal was cost reduction.
This goal has been achieved through a variety of measures.
The most impactful measures are:

- Housing production in one process step - ring gear toothing by power-skiving
- Standardized input interfaces for P and PH (Q)
  - Same input stages for 2-stage gearboxes
  - Same motor adapters
  - Free selection of the motor adapters, also ME- adapters for backlash reduced gearboxes
  - Same A- bearing flanges for direct attachment
- Standardized pinion diameter (pinion code Rc)
  - Less variance of the input planet carriers in 2-stage gearboxes
  - Less variance in the couplings (ME and MF)

Since we have significantly increased the performance of the gearboxes at the same time, we will not generally pass on the cost reductions to our customers. For price sensitive customers and applications, however we will use the greater flexibility in individual cases. The sales management will decide on a case-by-case basis which discounts or net prices may be made.

- The gross prices of basic P / PH / PHQ basic gearboxes remain unchanged
- The gross prices of motor adapters ME and MF remain unchanged

- The gross additional prices for the FKM shaft seal option have been reduced for the PH. Additional prices for P- and PH- are now the same.

| Gearbox | Additional price FKM shaft sealing |
|---|---|
| **P3/PH3** | 25€ |
| **P4/PH4/PHQ4** | 27€ |
| **P5/PH5/PHQ5** | 30€ |
| **P7/PH7/PHQ7** | 33€ |
| **P8/PH8/PHQ8** | 36€ |

- However, when selecting backlash-reduced gearboxes with all options (red. backlash/D-bearing (only for P)/FKM), a slight price increase may still occur.
  This price increase mainly affects PH gearheads. For the P gearunits only the two-stage P3 is affected.
  In the attachment we provide you with a table in which you can see exactly which gearboxes are affected to what extent and how high the respective price increases are. You will find the table „Gross price comparison G2 vs. G3 without motor adapter" in the attachment.
- In the past, an FKM shaft seal was automatically included when selecting a backlash-reduced gear unit. However, for most applications of a backlash reduced gearbox an FKM shaft seal is not required.
  Here it should be checked whether the customer really needs an FKM shaft seal.
- A significant price reduction can be achieved for the customer if he switches from an MF to an ME adapter. Information on this can be found in chapter 7.6.
- If it is absolutely necessary to make the same price as for G2, this must be done via the net price (ZNET).
- Price change took place in SAP on 01. March, 2020.
- Here we show a few examples of possible price reductions or price increases. For a selection with or without FKM shaft sealing ring or ME or MF adapter. See at next page.

P-unit:

Biggest possible price reduction

| | P832_MF | P832_MF | P832_ME | P832_ME | PA822_MF |
|---|---|---|---|---|---|
| | 2.005 € | 2.005 € | 2.005 € | 2.005 € | 2.504 € |
| adapter | 533 € | 533 € | 365 € | 365 € | 533 € |
| red. backlash | 201 € | 201 € | 201 € | 201 € | |
| D-bearing | 85 € | 85 € | 85 € | 85 € | |
| FKM | 36 € | - € | 36 € | - € | |
| | 2.860 € | 2.824 € | 2.692 € | 2.656 € | 3.037 € |
| **Price change** | **-6%** | **-7%** | **-11%** | **-13%** | |

Biggest possible price increase

| | P332_MF | P332_MF | P332_ME | P332_ME | PA322_MF |
|---|---|---|---|---|---|
| | 1.035 € | 1.035 € | 1.035 € | 1.035 € | 1.105 € |
| adapter | 363 € | 363 € | 171 € | 171 € | 363 € |
| red. backlash | 104 € | 104 € | 104 € | 104 € | |
| D-bearing | 41 € | 41 € | 41 € | 41 € | |
| FKM | 25 € | - € | 25 € | - € | |
| | 1.568 € | 1.543 € | 1.376 € | 1.351 € | 1.468 € |
| **Price change** | **7%** | **5%** | **-6%** | **-8%** | |

PH-unit:

Biggest possible price reduction

| | PH332_MF | PH332_MF | PH332_ME | PH332_ME | PHA322_MF |
|---|---|---|---|---|---|
| | 1.331 € | 1.331 € | 1.331 € | 1.331 € | 1.558 € |
| adapter | 363 € | 363 € | 171 € | 171 € | 363 € |
| red. backlash | 134 € | 134 € | 134 € | 134 € | |
| | | | | | |
| FKM | 25 € | - € | 25 € | - € | |
| | 1.853 € | 1.828 € | 1.661 € | 1.636 € | 1.921 € |
| **Price change** | **-4%** | **-5%** | **-14%** | **-15%** | |

Biggest possible price increase

| | PH531_MF | PH531_MF | PH531_ME | PH531_ME | PHA521_MF |
|---|---|---|---|---|---|
| | 1.283 € | 1.283 € | 1.283 € | 1.283 € | 1.363 € |
| adapter | 391 € | 391 € | 226 € | 226 € | 391 € |
| red. backlash | 129 € | 129 € | 129 € | 129 € | |
| | | | | | |
| FKM | 30 € | - € | 30 € | - € | |
| | 1.833 € | 1.803 € | 1.668 € | 1.638 € | 1.754 € |
| **Price change** | **5%** | **3%** | **-5%** | **-7%** | |

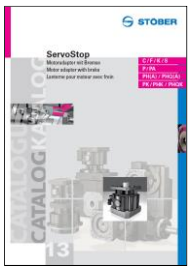
# 9. Media

## 9.1 Catalogue

The catalogue name "ServoFit" is no longer used from Generation 3 onwards. New catalogue name "Servo gearboxes".

The publication dates of the catalogues below refer to the German editions. The foreign-language versions always appear 4 weeks later.

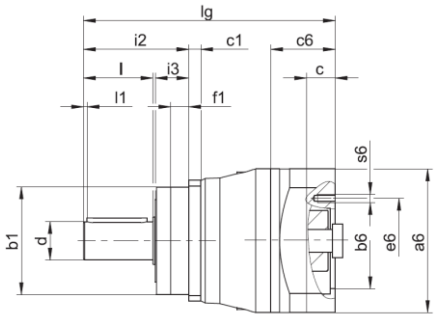
The exception is the servo gearbox catalogue, where the English version will be published as early as 15.10.2019.

| Servo Gear Units | Rack and Pinion | Synchronous-EZ | Lean motors | ServoStop |
|---|---|---|---|---|
| 01.10.2019 | 01.04.2020 | 01.01.2020 | 01.10.2020 | 01.07.2020 |
|  |  |  |  |  |
| Synchron.-ED/EK | | | | ServoCool |
|  | | | |  |

- Only the largest possible coupling is shown in the catalogue. This makes the selection lists in the catalog clearer and the catalog not unnecessarily inflated.
  Smaller possible coupling sizes can be selected in the STÖBER configurator. The smaller mass moments of inertia associated with the smaller couplings can also be determined here. To do this, the gear unit must be configured, and the technical data sheet downloaded.
  ServoSoft is simpler. Here the gearboxes with all coupling sizes can be selected. The corresponding mass moments of inertia are taken over directly in the drive design and used for the calculation.

| i | Typ | $n_{1MAXDB}$ [min⁻¹] | $n_{1MAXZB}$ [min⁻¹] | $d_{MW}$ [mm] | $J_1$ [kgcm²] | m [kg] | $\Delta\varphi_2$ [arcmin] | $\Delta\varphi_{2red}$ [arcmin] | $C_2$ [Nm/arcmin] | $L_{pA}$ [dB(A)] | $M_{2N}$ [Nm] | $M_{2acc}$ [Nm] | $M_{2accHT}$ [Nm] | $M_{2NOT}$ [Nm] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **P531 ($M_{2acc,max}$ = 385 Nm)** | | | | | | | | | | | | | | |
| 3,000 | P531_0030 ME | 2500 | 5000 | ≤32 | 5,3 | 6,2 | 3,0 | 1,0 | 33 | 64 | 120 | 200 | 200 | 400 |
| 3,000 | P531_0030 MEL | 2500 | 5000 | ≤38 | 8,8 | 7,2 | 3,0 | 1,0 | 33 | 64 | 120 | 200 | 200 | 400 |
| 4,000 | P531_0040 ME | 3000 | 6000 | ≤32 | 3,7 | 6,2 | 3,0 | 1,0 | 34 | 62 | 210 | 300 | 320 | 600 |
| 4,000 | P531_0040 MEL | 3000 | 6000 | ≤38 | 7,2 | 7,2 | 3,0 | 1,0 | 34 | 62 | 210 | 300 | 320 | 600 |
| 5,000 | P531_0050 ME | 3500 | 7000 | ≤32 | 3,2 | 6,2 | 3,0 | 1,0 | 34 | 60 | 210 | 350 | 385 | 700 |
| 5,000 | P531_0050 MEL | 3500 | 7000 | ≤38 | 6,8 | 7,2 | 3,0 | 1,0 | 34 | 60 | 210 | 350 | 385 | 700 |

- The complete length dimension of the gearbox with an adapter is now given as "lg".




- Only one motor connection flange per size is shown in the catalogue. The other motor connection flanges can be found in the STOBER Configurator.

**Beispielmaße Motoranschluss + Gesamtlänge**

| Typ | □a6 | Ø$b6^{H7}$ | c | c6 | Ø$e6^{H7}$ | lg | s6 |
|---|---|---|---|---|---|---|---|
| P231 | 55 | 40,0 | 15 | 32,0 | 63 | 124,5 | M5 |
| P232 | 55 | 40,0 | 15 | 32,0 | 63 | 156,5 | M5 |
| P331 | 75 | 60,0 | 18 | 51,5 | 75 | 171,0 | M5 |
| P332 | 55 | 40,0 | 15 | 32,0 | 63 | 188,5 | M5 |
| P431 | 100 | 95,0 | 21 | 56,0 | 115 | 195,0 | M8 |
| P432 | 75 | 60,0 | 18 | 51,5 | 75 | 236,5 | M5 |
| P531 | 120 | 80,0 | 24 | 64,0 | 100 | 241,0 | M6 |
| P532 | 100 | 95,0 | 21 | 56,0 | 115 | 284,5 | M8 |
| P731 | 150 | 110,0 | 26 | 76,0 | 130 | 294,0 | M8 |
| P732 | 120 | 80,0 | 24 | 64,0 | 100 | 342,0 | M6 |
| P831 | 204 | 130,0 | 35 | 94,0 | 165 | 353,0 | M10 |
| P832 | 150 | 110,0 | 26 | 76,0 | 130 | 402,5 | M8 |
| P931 | 230 | 180,0 | 43 | 108,0 | 215 | 439,0 | M12 |
| P932 | 204 | 130,0 | 35 | 94,0 | 165 | 511,0 | M10 |

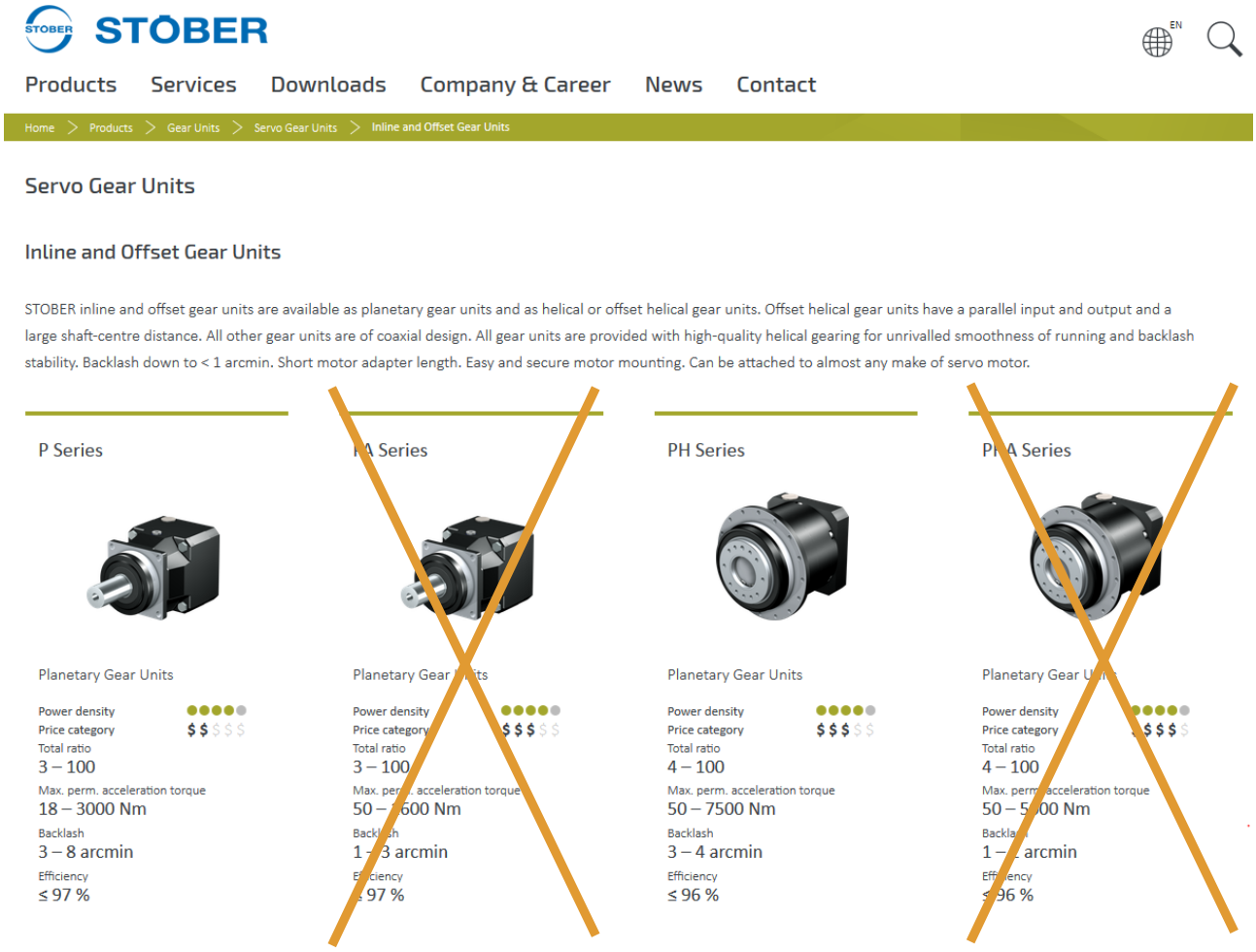
In der obigen Tabelle finden Sie Beispiel-Motoranschlussmaße für den Motoradapter ME. **Beachten Sie, dass sich die Maße c6 und lzg entsprechend verlängern, wenn das Maß c länger wird.**

Weitere Motoranschlussmaße für die Motoradapter ME, MEL, MF und MFL finden Sie in unserem STÖBER Configurator unter https://configurator.stoeber.de/de-DE/. Hier können Sie sich direkt ein 3D-Modell Ihres Antriebs herunterladen.

- PHA9, PHQA9 and PHVA9 are not included in the new catalogue as there is no extra chapter for "A" gearboxes. For these products please use the old catalogues or the STÖBER Configurator.

## 9.2 Internet / Intranet

- The chapters "PA, PHA and PHQA" are omitted. They will be replaced by the option "reduced backlash".




- STÖBER Configurator: Sizes are enabled according to availability.
  See schedule in chapter 2.1.
  Sizes 2-4 be enabled in KW 42.
  It is not possible to view generation 2 and 3 at the same time.
- Drawing catalog internal
  After the introduction in the STÖBER Configurator, all Generation 2 gearboxes are still available at http://satcad.stoeber.de/ For English Language switch on this page to English.
- The homepage is completely converted to Generation 3. Here is a step-by-step conversion not possible. Conversion takes place in week 41.

# 10. Calculation programs

## 10.1 SERVOsoft

The geared motors, rack and pinion drives and adapter gears are renewed in G3. The G2 adapter gearboxes will also be available.

For scheduling and data volume reasons we will start in the middle of October with certain restrictions:

- Adapter gearboxes standard and reduced backlash only with the combination ME(L)
- Geared motors with EZ/LM
- All gearboxes only with standard bearings
- Integration of the new Derating Factor $fB_{ZB}$
- Combination gearbox only with standard backlash

Generation 2 was removed on 1.04.2021 for the launch of the new generation PE, because we had to limit the database volume.

If you need the database with generation 2 in the future, it is stored under the link below. You can insert it as you are already used to with the third-party motor database.

https://stoebergermany-my.sharepoint.com/:f:/g/personal/ronja_neunecker_stoeber_de/EmGS2t56HmRPhW0eaWznu9IBU2CRPECdFOMy0b-Q5XKCDA?e=QicK4S

## 10.2 GETBER

GETBER is a calculation tool that we use internally to calculate safety margins and bearing life.

The R&D and product management department have access to this calculation tool.

We will also use GETBER for the G3 on customer request via the Area Sales Managers.

By October, all Generation 3 gearboxes will be available with standard backlash and ME adapters including angular contact roller bearings.

The low-backlash version is expected to be extended from the middle of October.

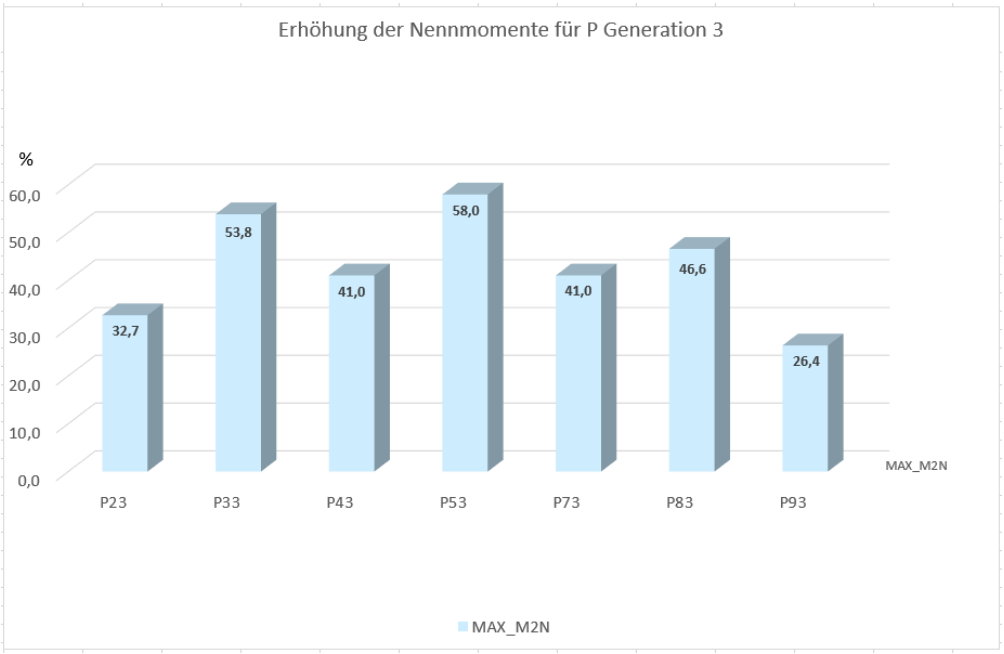
Service life calculations as before on request from SPG.

# 11. FAQ‘s

1. Are higher torques permissible in G3?

In most cases, yes. For a rough overview of the improvements of the sizes in comparison we have deposited diagrams in the comparison presentation G2-G3.

For a detailed comparison, take a look at the comparison diagrams attached. Each individual gear ratio is also compared for each size. They are available in German and English for all sizes.




Example: out of the presentation G2-G3 – Nominal Torques P-Gearbox

2. Are generally higher technical data permissible for G3?

The gearboxes of the G3 are equally good or better in all technical criteria. Due to more extensive and more precise calculation methods, slightly lower catalogue values have resulted in a few criteria. In other words, the catalogue data of the G2 could not all be verified with the current calculation methods.

We have created very extensive comparison documents. We will be happy to provide you the documents as described in Chapter 1.

3. Are higher axial and radial forces permissible?

The proven output shaft bearings of the P series have been incorporated into the new Generation 3 series. This allows our customers to continue to benefit from the advantages of optimization to meet their specific requirements in the future. The associated low friction increases the efficiency and reduces the heat loss.

For purely axial loads, the values could be increased by up to 150%.

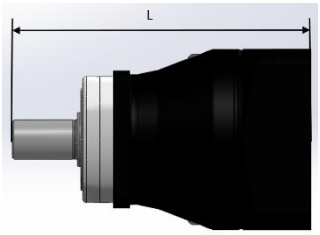
For size 7, slightly larger bearings could be provided. This is reflected in slightly higher permissible values, or the service life increases with the same loads.

In the PH(Q) series, the proven angular contact bearings from the G2 have been adopted throughout.

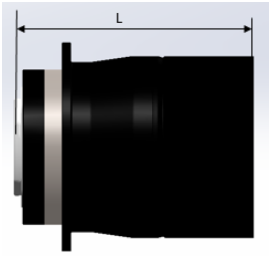
As an option, we now offer a reinforced bearing arrangement "V" in the G3 for sizes PH3/PH(Q)4-PH(Q)5.

Therefore, an increase of the shaft load axial up to 34.9 % and radial up to 39.5 % or with the same load up to 3 times longer service life can be achieved. However, there is also a slightly higher friction due to the system.

4. How does the overall length change in G3?




| | G2 ME L [mm] | G3 ME L [mm] | Reducing [mm] | G2 MEL L [mm] | G3 MEL L [mm] | Reducing [mm] |
|---|---|---|---|---|---|---|
| P221 - P231 | 109,5 | 109,5 | 0,0 | 129,0 | 129,0 | 0,0 |
| P222 - P232 | 141,5 | 141,5 | 0,0 | 161,0 | 161,0 | 0,0 |
| P321 - P331 | 153,0 | 145,5 | 7,5 | 159,3 | 147,0 | 12,3 |
| P322 - P332 | 173,5 | 163,0 | 10,5 | 193,0 | 182,5 | 10,5 |
| P421 - P431 | 174,0 | 165,5 | 8,5 | 185,5 | 178,5 | 7,0 |
| P422 - P432 | 218,5 | 202,5 | 16,0 | 224,8 | 204,0 | 20,8 |
| P521 - P531 | 217,0 | 210,5 | 6,5 | 233,0 | 223,0 | 10,0 |
| P522 - P532 | 263,5 | 239,5 | 24,0 | 275,0 | 252,5 | 22,5 |
| P721 - P731 | 268,0 | 264,5 | 3,5 | 293,0 | 287,5 | 5,5 |
| P722 - P732 | 318,0 | 302,5 | 15,5 | 334,0 | 315,0 | 19,0 |
| P821 - P831 | 318,0 | 311,5 | 6,5 | 334,0 | 320,5 | 13,5 |
| P822 - P832 | 376,5 | 356,5 | 20,0 | 401,5 | 379,5 | 22,0 |
| P921 - P931 | 396,0 | 380,5 | 15,5 | - | - | - |
| P922 - P932 | 476,0 | 463,5 | 12,5 | 492,0 | 472,5 | 19,5 |




| | G2 ME L [mm] | G3 ME L [mm] | Reducing [mm] | G2 MEL L [mm] | G3 MEL L [mm] | Reducing [mm] |
|---|---|---|---|---|---|---|
| PH321 - PH331 | 102,5 | 98,5 | 4,0 | 108,8 | 100,0 | 8,8 |
| PH322 - PH332 | 119,0 | 116,0 | 3,0 | 138,5 | 135,5 | 3,0 |
| PH(Q)421 – PH(Q)431 | 120,0 | 113,5 | 6,5 | 131,5 | 126,5 | 5,0 |
| PH(Q)422 – PH(Q)432 | 164,5 | 150,5 | 14,0 | 170,8 | 152,0 | 18,8 |
| PH(Q)521 – PH(Q)531 | 134,0 | 132,0 | 2,0 | 150,0 | 144,5 | 5,5 |
| PH(Q)522 – PH(Q)532 | 180,5 | 161,0 | 19,5 | 192,0 | 174,0 | 18,0 |
| PH(Q)721 – PH(Q)731 | 164,0 | 161,0 | 3,0 | 189,5 | 184,0 | 5,5 |
| PH(Q)722 – PH(Q)732 | 214,0 | 199,0 | 15,0 | 230,0 | 211,5 | 18,5 |
| PH(Q)821 – PH(Q)831 | 218,0 | 218,0 | 0,0 | 234,0 | 236,0 | -2,0 |
| PH(Q)822 – PH(Q)832 | 277,0 | 263,0 | 14,0 | 303,0 | 286,0 | 17,0 |

5. Can interference contours occur with the new design?

Due to the design change of the planetary gearboxes and the standardization of the motor adapters (ME and MF for P and PH(Q)), all motor adapters are now screwed from behind to the back of the gearboxes. This change meant that the housing diameter, and thus the square size of the motor adapters, had to be increased for some sizes. This also applies to direct mounting. Further information can be found in chapters 6.1 - 6.3.

In general, however, we recommend an interference contour check based on the new 3D volume models.

6. How has the type code changed?

| Gear Unit Type | Size | Generation | Number of Stages | Housing Design | Shaft Design | Bearing Design | Backlash | Ratio Code | Input Option |
|---|---|---|---|---|---|---|---|---|---|
| P | 4 | 3 | 1 | S | G | S | S | 0050 | ME |
| PH(Q) | 4 | 3 | 1 | S | F | S | S | 0050 | ME |
| | | | | | | | | | |
| Varianten: | | | | | | | | | |
| P | | | | S | G | S | S | | ME(L) |
| | | | | X | P | D | R | | MF(L) |
| | | | | | | Z | | | MB |
| PH(Q) | | | | S | F | S | S | | ME(L) |
| | | | | X | | V | R | | MF(L) |
| | | | | | | | | | MB |

Option

Change in the Type code

Special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