

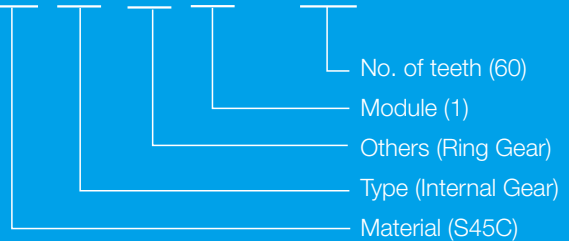
Internal Gears

Catalog Number of Stock Gears

The Catalog Number for stock gears is based on the simple formula listed below. Please order gears by specifying the Catalog Numbers.

(Example) Internal Gears

K S I R 1 - 60



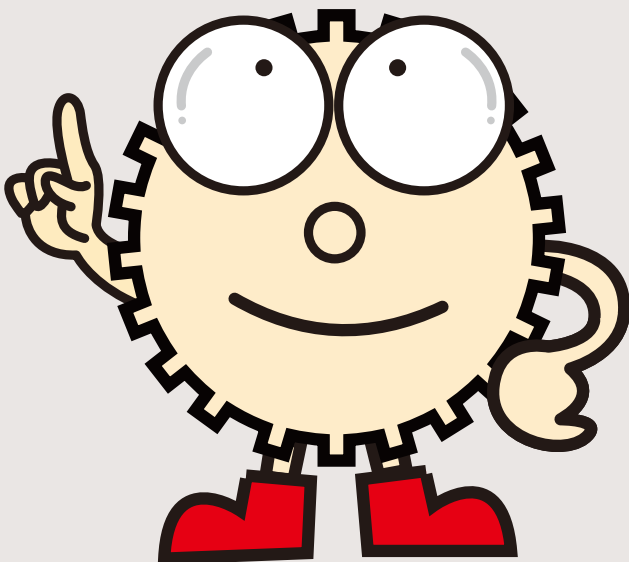
Material
S S45C

Type
I Internal Gears

Other Information
R Ring Gears

Feature Icons

- RoHS Compliant Product
- Re-machinable Product
- Finished Product
- Heat Treated Product
- Ground Gear
- Stainless Product
- Resin Product
- Copper Alloy Product
- Injection Molded Product
- Black Oxide coated Product



Spur Gears

Helical Gears

Internal Gears

Racks

CP Racks & Pinions

Miter Gears

Bevel Gears

Screw Gears

Worm Gear Pair

Bevel Gearboxes

Other Products

Characteristics



KHK stock internal gears are offered in modules 0.5 to 3 in 50 to 200 teeth. They can be used in many applications including planetary gear drives.

Catalog No.	KSI	KSIR
Module	0.5~3	2~3
Material	S45C	S45C
Heat Treatment	-	-
Tooth Surface Finish	Cut	Cut
Precision JIS B 1702-1:1998	N8 NOTE 1	N9
Secondary Operations	Possible	Possible
Features	A popular type of internal gear; low cost and suitable for many applications.	Ring gear large in size / number of tooth. It can be cut to make segment gears and corner racks.

[Note 1] The Product accuracy class having a module less than 0.8 corresponds to 'equivalent' as shown in the table.

Selection Hints



Please select the most suitable products by carefully considering the characteristics of items and contents of the product tables. It is also important to read all applicable notes before the final selection.

1. Caution in Selecting the Mating Gears

KHK stock internal gears can mate with any spur gears of the same module, however, there are cases of involute, trochoid and trimming interference occurrences, depending on the number of teeth of the mating gear. Various types of interference and their symptoms and causes are tabulated below, also shown, the number of teeth of allowable mating pinions.

Interferences and the symptoms

TYPE	SYMPTOMS	CAUSES
Involute interference	The tip of the internal gear digs into the root of the pinion.	Too few teeth on the pinion.
Trochoid interference	The exiting pinion tooth contacts the internal gear tooth.	Too little difference in number of teeth of the two gears.
Trimming interference	Pinion can slide in or out axially but cannot move radially.	Too little difference in number of teeth of the two gears.

Allowable Mating Pinions and Number of Teeth

No. of teeth of Internal Gear	No. of teeth of Allowable Mating Pinions		
	Lower limit No. of teeth by Involute interference	Upper limit No. of teeth by Trochoid interference	Upper limit No. of teeth by Trimming interference
50	22	41	33
60	21	51	43
80	20	72	64
100	19	92	84
120	19	112	104
160	19	152	144
200	18	192	184

Established equipment and technology. Custom Gears are also available.

Diameter Ø700mm maximum, Module 6.5 maximum, Cutting Stroke 170 mm



Gear cutting by CNC Gear Shaper

2. Caution in Selecting Gears Based on Gear Strength

The gear strength values shown in the product pages were computed by assuming a certain application environment. Therefore, they should be used as reference only. We recommend that each user computes his own values by applying the actual usage conditions. The table below contains the assumptions established for these products in order to compute gear strengths.

Calculation assumptions for Bending Strength of Gears

Item	Catalog No.	KSI	KSIR
Formula NOTE 1		Formula of spur and helical gears on bending strength (JGMA401-01)	
No. of teeth of mating gears		30	
Rotation		100rpm	
Durability		Over 10 ⁷ cycles	
Impact from motor		Uniform load	
Impact from load		Uniform load	
Direction of load		Bidirectional	
Allowable beam stress at root σ_{Ftm} (kgf/mm ²) NOTE 2		19	
Safety factor S_F		1.2	

Calculation assumptions for Surface Durability (Except where it is common with bending strength)

Item	Catalog No.	KSI	KSIR
Formula NOTE 1		Formula of spur and helical gears on surface durability (JGMA402-01)	
Kinematic viscosity of lubricant		100cSt(50°C)	
Gear support		Symmetric support by bearings	
Allowable Hertz stress σ_{Hlim} (kgf/mm ²)		49	
Safety factor S_H		1.15	

Note 1 The gear strength formula is based on JGMA (Japanese Gear Manufacturers' Association) The units for the rotational speed (rpm) and the stress (kgf/mm²) are adjusted to the units needed in the formula.

Note 2 The allowable bending stress at the root σ_{Ftm} is calculated from JGMA401-01, and set to 2/3 of the value in the consideration of the use of planetary-, idler-, or other gear systems, loaded in both directions.

Application Hints

In order to use KHK stock internal gears safely, read the Application Hints carefully before proceeding. Also “1. Caution on Performing Secondary Operations”, “3. Notes on Starting Operations” and “4. Other Points to Consider in Applications” in the spur gear section should be consulted (Page 36).

1. Point of Caution in Assembling

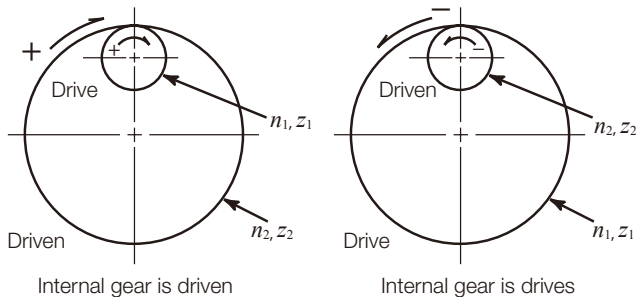
- ① KHK stock internal gears are designed to give the proper backlash when assembled using the center distance given by the formula below. The amount of backlash is given in the product table for each gear.

$$a = \frac{d_2 - d_1}{2}$$

Where
 a : Center distance
 d_1 : Pitch diameter of Pinion
 d_2 : Pitch diameter of Internal Gear

- ② Note that the direction of rotation of the internal gear is different from that of two spur gears in mesh.

Gear Ratio and Direction of Rotation



Gear Ratio $i = \frac{z_2}{z_1} = \frac{n_1}{n_2}$ z : No. of teeth
 n : Rotational speed

- ③ To use as a planetary gear drive, the following conditions must be satisfied.

Condition on number of teeth in planetary mechanism

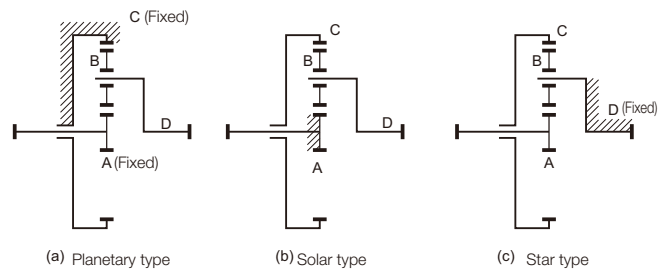
- Condition 1 ... $z_c = z_a + 2z_b$
- Condition 2 ... $\frac{z_a + z_c}{N} = \text{Integer}$
- Condition 3 ... $z_b + 2 < (z_a + z_b) \sin \frac{180^\circ}{N}$

z_a : No. of teeth of Sun Gear
 z_b : No. of teeth of Planet Gears
 z_c : No. of teeth of Internal Gear
 N : No. of Planet Gears

Example of combinations

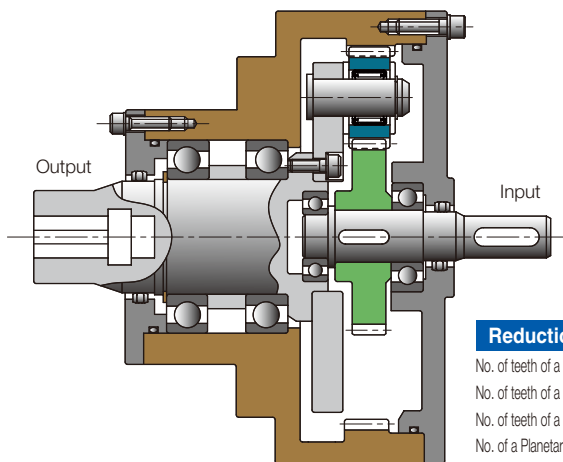
No. of teeth of internal gear	No. of planet gears	No. of teeth of sun gear	No. of teeth of planet gears	Reduction ratio of planetary type	Reduction ratio of solar type	Reduction ratio of star type
60	3	18	21	4.333	1.3	-3.333
80	3	16	32	6	1.2	-5
80	3	40	20	3	1.5	-2
100	3	20	40	6	1.2	-5
100	3	50	25	3	1.5	-2

Types of planetary gear reduction mechanism

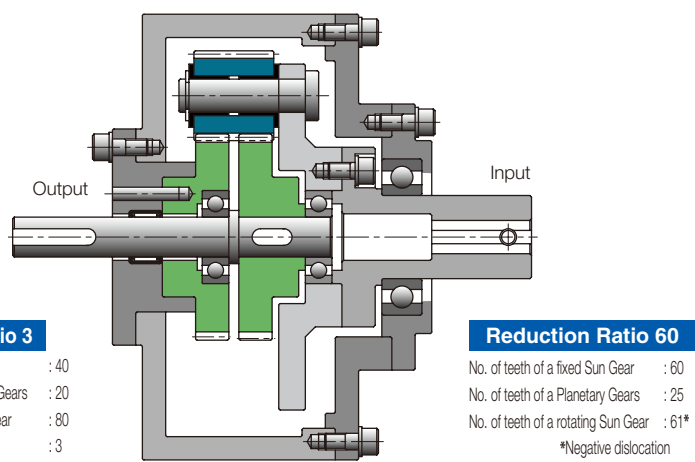


Application Examples

* The illustration is a design example, not a design for machinery or a device in actual use.



Planetary Gear Mechanism used in a reduction gear *



Mechanical Paradox Gear Mechanism used in a large reduction gear

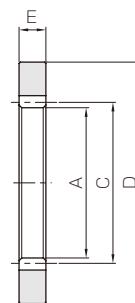


- Spur Gears
- Helical Gears
- Internal Gears**
- Racks
- CP Racks & Pinions
- Miter Gears
- Bevel Gears
- Screw Gears
- Worm Gear Pair
- Bevel Gearboxes
- Other Products



Specifications	
Precision grade	JIS grade N8 (JIS B1702-1: 1998)* JIS grade 4 (JIS B1702: 1976)
Gear teeth	Standard full depth
Pressure angle	20°
Material	S45C
Heat treatment	-
Tooth hardness	less than 194HB

* The precision grade of products with a module of less than 0.8 is equivalent to the value shown in the table.



T1

Catalog No. <small>New items indicated in blue letters.</small>	Module	No. of teeth	Shape	Internal dia.	Pitch dia.	Outside dia.	Face width	Allowable torque (N·m)		Allowable torque (kgf·m)		Backlash (mm)	Weight (kg)
				A	C	D	E	Bending strength	Surface durability	Bending strength	Surface durability		
KSI0.5-60	m0.5	60	T1	29	30	50	5	3.75	0.67	0.38	0.07	0.04~0.15	0.049
KSI0.5-80		80	T1	39	40	60	5	4.85	0.75	0.49	0.08	0.04~0.15	0.062
KSI0.5-100		100	T1	49	50	70	5	5.97	0.87	0.61	0.09	0.04~0.15	0.074
KSI0.8-60	m0.8	60	T1	46.4	48	75	8	15.4	2.87	1.57	0.29	0.05~0.16	0.16
KSI0.8-80		80	T1	62.4	64	90	8	19.9	3.24	2.03	0.33	0.05~0.16	0.20
KSI0.8-100		100	T1	78.4	80	105	8	24.5	3.75	2.50	0.38	0.05~0.16	0.23
KSI1-60	m1	60	T1	58	60	90	10	30.0	5.95	3.06	0.61	0.10~0.22	0.28
KSI1-80		80	T1	78	80	110	10	38.8	6.59	3.96	0.67	0.10~0.22	0.35
KSI1-100		100	T1	98	100	130	10	47.8	7.64	4.87	0.78	0.12~0.25	0.43
KSI1.5-50	m1.5	50	T1	72	75	115	15	87.1	20.9	8.88	2.13	0.13~0.29	0.70
KSI1.5-60		60	T1	87	90	130	15	101	20.6	10.3	2.10	0.13~0.29	0.81
KSI1.5-80		80	T1	117	120	160	15	131	23.3	13.4	2.38	0.13~0.29	1.04
KSI1.5-100		100	T1	147	150	190	15	161	27.0	16.5	2.75	0.15~0.32	1.26
KSI2-50	m2	50	T1	96	100	150	20	206	50.3	21.0	5.13	0.16~0.33	1.54
KSI2-60		60	T1	116	120	170	20	240	50.5	24.5	5.15	0.16~0.33	1.79
KSI2-80		80	T1	156	160	210	20	311	57.0	31.7	5.81	0.16~0.33	2.28
KSI2-100		100	T1	196	200	250	20	382	65.7	39.0	6.70	0.17~0.37	2.77
KSI2.5-50	m2.5	50	T1	120	125	185	25	403	101	41.1	10.3	0.17~0.37	2.87
KSI2.5-60		60	T1	145	150	210	25	469	101	47.8	10.3	0.17~0.37	3.33
KSI2.5-80		80	T1	195	200	260	25	607	114	61.9	11.6	0.17~0.37	4.25
KSI3-50	m3	50	T1	144	150	220	30	697	178	71.0	18.1	0.19~0.41	4.79
KSI3-60		60	T1	174	180	250	30	811	178	82.7	18.2	0.19~0.41	5.57

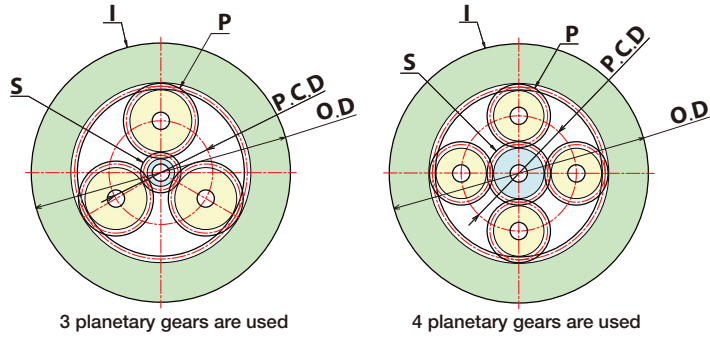
- [Caution on Product Characteristics]
- ① The backlash values shown in the table are the theoretical values for the normal direction for the internal ring in mesh with a 30 tooth KSS spur gear.
 - ② The allowable torque shown in the table are the calculated values according to the assumed usage conditions. Please see page 366 for more details
 - ③ Please check for the involute interference, trochoid interference and trimming interference prior to using internal gears.

- [Caution on Secondary Operations]
- ① Please read "Caution on Performing Secondary Operations" (Page 36) when performing modifications and/or secondary operations for safety concerns.
 - ② Avoid performing secondary operations that narrow the tooth width as it affects precision and strength.

***Please see book one for additional products in these modules.**

★ For products not categorized in our Stock Gear series', custom gear production services with **short lead times** is available. For details see page VI.

Planetary Gear Systems created by using Stock Gears



Stock internal gears and spur gears working together will allow you to create planetary gear devices. In the table below, we introduce examples of planetary gear systems, where gears are assembled without meshing interference. The velocity ratio (*Note 1) in the table are for planetary gear systems created with a stationary internal gear. Used as speed deceleration devices from input by the sun gear and output by the carrier. Selection of the number of teeth also enables you to create various planetary gear devices with different transmission ratios.

Velocity ratio Note 1	Stock gears used in the system										Allowable transmission torque (kgf·m)				Total weight (kg)	
	Internal gears (I)			Planetary gears (P)				Sun gear (S)		Sun gear _T1		Planetary carrier _T2				
	OD(mm)	Catalog No.	No. of teeth	Catalog No.	No. of teeth	Quantity	P.C.D(mm)	Equal angles	Catalog No.	No. of teeth	Bending strength	Surface durability	Bending strength	Surface durability		
6	50	KSI0.5-60	60	KSS0.5-24A	24	3	18	120°	KSS0.5-12	12	0.072	0.0003	0.43	0.013	0.10	
	75	SI0.8-60		KSS0.8-24A			28.8		KSS0.8-12		0.30	0.0011	1.78	0.057	0.30	
	90	KSI1-60		KSSA1-24			36		KSS1-12		0.58	0.0023	3.47	0.11	0.48	
	130	KSI1.5-60		KSSA1.5-24			54		KSS1.5-12		1.77	0.0081	10.7	0.40	1.20	
	170	KSI2-60		KSSA2-24			72		KSS2-12		4.21	0.020	25.2	0.99	2.66	
	210	KSI2.5-60		KSSA2.5-24			90		KSS2.5-12		8.21	0.040	49.3	1.98	5.03	
	250	KSI3-60		KSSA3-24			108		KSS3-12		14.2	0.070	85.2	3.49	8.57	
	60	KSI0.5-80	80	KSS0.5-32A	32	3	24	120°	KSS0.5-16A	16	0.12	0.0005	0.75	0.027	0.11	
	90	SI0.8-80		KSS0.8-32A			38.4		KSS0.8-16A		0.51	0.0024	3.05	0.12	0.38	
	110	KSI1-80		KSSA1-32			48		KSS1-16		0.99	0.0047	5.96	0.24	0.57	
	160	KSI1.5-80		KSSA1.5-32			72		KSS1.5-16		3.35	0.026	20.1	1.32	1.72	
	210	KSI2-80		KSSA2-32			96		KSS2-16		7.95	0.064	47.7	3.22	3.85	
	260	KSI2.5-80		KSSA2.5-32			120		KSS2.5-16		15.5	0.13	93.2	6.45	7.33	
	5	70	KSI0.5-100	100	KSS0.5-40A	40	4	30	90°	KSS0.5-20A	20	0.23	0.0019	1.39	0.10	0.18
		105	KSI0.8-100		KSS0.8-40A			48		KSS0.8-20A		0.95	0.0082	5.68	0.41	0.59
130		KSI1-100	KSSA1-40		60			KSS1-20		1.85		0.016	11.1	0.82	0.84	
190		KSI1.5-100	KSSA1.5-40		90			KSS1.5-20		6.24		0.058	37.5	2.90	2.62	
250		KSI2-100	KSSA2-40		120			KSS2-20		14.8		0.14	88.8	7.09	6.01	
60		KSI0.5-80	80		KSS0.5-30A			30		4		25	90°	KSS0.5-20A	20	0.23
90	KSI0.8-80	KSS0.8-30A		40	KSS0.8-20A	0.93	0.0050		4.65		0.30	0.40				
110	KSI1-80	KSSA1-30		50	KSS1-20	1.82	0.010		9.08		0.60	0.59				
160	KSI1.5-80	KSSA1.5-30		75	KSS1.5-20	6.13	0.035		30.63		2.13	1.86				
210	KSI2-80	KSSA2-30		100	KSS2-20	14.5	0.087		72.6		5.21	4.18				
260	KSI2.5-80	KSSA2.5-30		125	KSS2.5-20	28.4	0.17		142		10.4	7.97				
3	60	KSI0.5-80	80	KSS0.5-20A	20	4	30	90°	KSS0.5-40A	40	0.46	0.0016	1.39	0.10	0.13	
	90	KSI0.8-80		KSS0.8-20A			48		KSS0.8-40A		1.89	0.0068	5.68	0.41	0.35	
	110	KSI1-80		KSSA1-20			60		KSS1-40		3.70	0.014	11.1	0.82	0.60	
	160	KSI1.5-80		KSSA1.5-20			90		KSS1.5-40		12.5	0.048	37.5	2.91	1.77	
	210	KSI2-80		KSSA2-20			120		KSS2-40		29.6	0.12	88.8	7.12	3.93	
	260	KSI2.5-80	KSSA2.5-20	150	KSS2.5-40	57.8	0.24	173	14.3	7.47						
	70	KSI0.5-100	100	KSS0.5-25A	25	3	37.5	120°	KSS0.5-50A	50	0.47	0.0020	1.42	0.12	0.16	
	105	KSI0.8-100		KSS0.8-25A			60		KSS0.8-50A		1.94	0.0084	5.83	0.51	0.43	
	130	KSI1-100		KSSA1-25			75		KSS1-50		3.79	0.017	11.4	1.01	0.75	
	190	KSI1.5-100		KSSA1.5-25			112.5		KSS1.5-50		12.8	0.060	38.4	3.58	2.24	
250	KSI2-100	KSSA2-25		150			KSS2-50		30.4		0.15	91.1	8.79	5.02		

Calculation of Allowable Transmission Torque

One advantage of a planetary gear system is that they share load burdens by grouping multiple planetary gears, enabling high torque capacity transmission. The following formula is the calculation method for T1 (Allowable transmission torque of Sun Gear) and T2 (Allowable transmission torque of Planetary Carrier), shown in the table.

$$T1 = Ts \cdot Zp \cdot \eta \text{ (kgf} \cdot \text{m)} \dots \dots \dots (1)$$

$$T2 = Ts \cdot Zp \cdot u \cdot \eta \text{ (kgf} \cdot \text{m)} \dots \dots \dots (2)$$

Where:

- Ts : Allowable transmission torque for a Sun gear (kgf · m) on a meshed pair of sun gear and planetary gear.
For a sun gear meshed with a planetary gear, the number of revolutions is set to 100rpm.
- Zp : Number of planetary gears used in the system
- u : Velocity ratio
- η : Contact efficiency for torque transmission
In consideration of machining accuracy, variation in tooth thickness or other factors on the planetary carrier, the contact efficiency is set to 75%.



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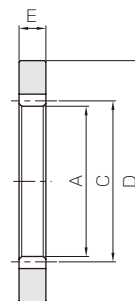
Worm Gear Pair

Bevel Gearboxes

Other Products



Specifications	
Precision grade	JIS grade N8 (JIS B1702-1: 1998) JIS grade 4 (JIS B1702: 1976)
Gear teeth	Standard full depth
Pressure angle	20°
Material	S45C
Heat treatment	-
Tooth hardness	less than 194HB



T1

Catalog No.	Module	No. of teeth	Shape	Internal dia.				Allowable torque (N·m)		Allowable torque (kgf·m)		Backlash (mm)	Weight (kg)
				A	C	D	E	Bending strength	Surface durability	Bending strength	Surface durability		
KSIR2-120	m2	120	T1	236	240	286	20	413	68.8	42.1	7.02	0.17~0.37	2.98
KSIR2-200		200	T1	396	400	446	20	677	110	69.0	11.2	0.20~0.41	4.80
KSIR2.5-120	m2.5	120	T1	295	300	355	25	807	138	82.3	14.0	0.19~0.41	5.55
KSIR2.5-200		200	T1	495	500	555	25	1320	220	135	22.5	0.22~0.46	8.94
KSIR3-120	m3	120	T1	354	360	424	30	1390	244	142	24.9	0.22~0.45	9.28
KSIR3-160		160	T1	474	480	544	30	1840	315	188	32.1	0.22~0.45	12.1

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