GAM GSL Series
ROBOTIC STRAIN WAVE GEARBOXES
Robotic Strain Wave Gearboxes

GAM's GSL Series Robotic Strain Wave Gearboxes provide zero-backlash and high torque in a small, lightweight gearbox.

- Backlash of ≤0.5 arcmin (≤30 arcsec)
- High repeatability and positional accuracy for fine positioning
- High reduction ratios in a single stage: 50:1 to 160:1
- Simple design for integration into housing or machine
- High torque density with low inertia
- Drops in for popular competitor gearboxes

Strain Wave Operating Principle
Strain wave gear reducers have three basic components:

Wave Generator
Made up of an elliptical cam and a ball bearing. It is usually attached to the driving component. The inner ring of the bearing is fixed around the cam causing the bearing to deform to an elliptical shape.

Flexspline
An elastic, thin-walled component with gear teeth on the outer surface. The flexspline is either cup or hat shaped, with a rigid base for transmitting torque. Most commonly the output component.

Circular Spline
Rigid steel ring with internal teeth. It has 2 more teeth than the flexspline. Most commonly the fixed component.

Operation
1. The Wave Generator mounts inside the Flexspline forcing the Flexspline into an elliptical shape.
2. The Flexspline teeth engage the Circular Spline teeth along the major axis of the ellipse of the Wave Generator. The Flexspline has two fewer teeth than the Circular Spline.
3. The rotation of the Wave Generator continuously deforms the Flexspline resulting in the teeth engaging and disengaging the teeth of the Circular Spline, rotating the Flexspline in the opposite direction.
4. As the Wave Generator moves through 360°, since the Flexspline has two fewer teeth it "runs out" of teeth to engage with the Circular Spline before it gets to the first tooth and so moves two teeth in the opposite direction of the Wave Generator.
5. The distance (degrees) the Flexspline rotates depends on the reduction ratio: at 50:1 it moves 360/50 or 7.2°.
GSL ROBOTIC STRAIN WAVE GEARBOXES

GSL-C: Cup-Style

- **Cup-shaped** flexspline
- Smaller diameter
- Flange output eases mounting of pinions or shafts

GSL-H: Hat-Style

- **Hat-shaped** flexspline
- Lower profile
- Rotating outer housing useful for AGV wheels or robot joints

**GSL Relative Rotation**

**Common Operation**

- Input
- Fixed
- Output

- Wave Generator
- Flexspline
- Opposite Direction
- Circular Spline
- Ratio, e.g. 50:1

**Alternate Operation**

- Input
- Output
- Fixed
- Ratio

- Wave Generator
- Circular Spline
- Same Direction
- Flexspline
- Ratio+1, e.g. 51:1

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**GSL Series Models**

**GSL-CS: Standard Profile (Cup)**
- Cup-Style Flexspline
- Small diameter

**GSL-CS-A/B**
- Keyed or set screw input
- Optional Oldham's coupling (B)
- Cup-style flexspline
- Frame sizes 014-032

**GSL-CT-A**
- Compact, low profile
- Keyed input
- Cup-style flexspline
- Frame sizes 014-017

**GSL-HT-A**
- Ultra-low profile
- Keyed input
- Hat-style flexspline
- Frame sizes 014-017

**GSL-HS: Standard Profile (Hat)**
- Hat-Style Flexspline
- Low Profile

**GSL-HS-A/B**
- Keyed or set screw input
- Optional Oldham's coupling (B)
- Cup-style flexspline
- Frame sizes 014-032

**GSL-HS-C**
- Hollow shaft input
- Frame sizes 014-040

**GSL-HS-D**
- Shaft input
- Frame sizes 014-032

**GSL-HS-E**
- Basic design
- Includes output bearing but no housing for more complete integration
- Frame sizes 014-032

**GSLC Components**
Includes wave generator, flexspline, and circular spline only for full integration into customer application

**GSLC-CS**
- Keyed input
- Cup-style flexspline

**GSLC-HS**
- Keyed input
- Hat-style flexspline
# GSL Technical Specifications

<table>
<thead>
<tr>
<th>Gearbox Style</th>
<th>GSL-CS</th>
<th>GSL-CT</th>
<th>GSL-HS</th>
<th>GSL-HT</th>
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<tbody>
<tr>
<td><strong>Frame Size</strong></td>
<td><strong>Input</strong></td>
<td><strong>014</strong></td>
<td><strong>017</strong></td>
<td><strong>020</strong></td>
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<td>Overall Diameter (mm)</td>
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<td>Overall Length (mm)</td>
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<td>Weight (kg)</td>
<td>A-B</td>
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<td>D</td>
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<tr>
<td>Nominal Torque (Nm)</td>
<td>50:1</td>
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<td>29.9</td>
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<td>120:1</td>
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<td>160:1</td>
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<td>Acceleration Torque (Nm)</td>
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<td>160:1</td>
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<td>Emergency Stopping Torque (Nm)</td>
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<td>40.3</td>
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<td>100:1</td>
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<td>120:1</td>
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<td>Rated Torque at 2000 rpm Input Speed (Nm)</td>
<td>50:1</td>
<td>6.2</td>
<td>18.4</td>
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<td>Average Allowable Input Speed (RPM)</td>
<td>3,000 RPM</td>
<td>3,500 RPM</td>
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<td>Maximum Input Speed (RPM)</td>
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<td>6,500</td>
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<td>Backlash (arcsec)</td>
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<tr>
<td>Life (hours)</td>
<td>15,000</td>
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</table>

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# GSL STRAIN WAVE GEARBOXES

## TYPE CODES FOR GSL-C SERIES

**Example:** GSL - CS - 025 - 050 - A - M0000 - H0000 - C0000

<table>
<thead>
<tr>
<th>Gearbox Series</th>
<th>Style/Profile</th>
<th>Frame Size</th>
<th>Ratio</th>
<th>Input</th>
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## TYPE CODES FOR GSL -H SERIES

**Example:** GSL - HS - 025 - 050 - A - M0000 - H0000 - C0000

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<th>Style/Profile</th>
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<th>Ratio</th>
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<tr>
<td></td>
<td></td>
<td>017</td>
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</table>

**Configuration Code** (Assigned by GAM)
**Output Code** (Assigned by GAM)
**Motor Code** (Assigned by GAM)
**Input Design**
- A = Keyed/Set Screw
- B = Keyed/Set Screw with Oldhams Coupling

**Gearbox Profile**
- S = Standard
- T = Compact Low Profile (014/017 only)

**Gearbox Series**
- GSL = With Housing
- GSLC = Gearing Only

**Gearbox Style**
- C = Cup

**Gearbox Size**
- 014, 017, 020, 025, 032

**Ratio**
- 050, 080, 100, 120, 160 [1:1]
GAM Gearbox Range

GAM offers a full range of gearboxes from planetary servo gearboxes through zero-backlash robotic gearboxes for a wide variety of applications.

### INCREASING PRECISION - DECREASING BACKLASH

<table>
<thead>
<tr>
<th>Torque Range (Nm)</th>
<th>Planetary EPL-F</th>
<th>Helical Planetary SPH-F</th>
<th>Cycloidal GCL</th>
<th>Strain Wave GSL</th>
<th>Robotic Planetary GPL</th>
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<tr>
<td>≤15</td>
<td>EPL-F-047 14</td>
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<td>16-25</td>
<td>EPL-F-064 42</td>
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<td>26 - 50</td>
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<td>SPH-F-075 100</td>
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<td>51 - 100</td>
<td>EPL-F-110 210</td>
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<td>EPL-F-140 340</td>
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<td>GPL-F-300 2690</td>
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</table>

- **Backlash:** ≤8-20 arcmin ≤1 - 3 arcmin ≤1 arcmin ≤0.5 arcmin (≤30 arcsec) ≤0.1 arcmin (≤6 arcsec)
- **Integral pre-stage option for additional ratio**

**Model Torque**

- GSL-CS-014 12.7
- GSL-CS-017 17
- GSL-CS-020 20
- GSL-CS-025 25
- GSL-CS-032 32
- GSL-CS-040 40
- GSL-CS-017 45
- GCL-F-020 167
- GCL-F-025 124
- GCL-F-032 248
- GPL-F-080 770
- GPL-F-112 1165
- GPL-F-160 1450
- GPL-F-224 1820
- GPL-F-300 2690
- GPL-F-400 3505

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Applications
The GSL can be used in a variety of applications with requirements such as:
- Zero-backlash and high positional accuracy
- Low profile, compact form-factor
- High torque ratio
- Full Integration into a mechanism or machine
Applications include:
- Robot joints
- Antenna and solar panel positioning
- Autonomous robotic vehicle drives

Find the your exact solution at GAM!
GAM's product range of gear reducers, couplings, and other specialized mechanical drive solutions is one of the largest in the industry. Even with such a wide offering, we realize that you may not find a standard product that meets your exact requirements.

One of our greatest strengths is our ability to modify standard designs, provide completely customized solutions, and integrated product assemblies to meet your specific application requirements. And, because of our flexible manufacturing, we can cost-effectively produce small batches of customized product in short lead-times.

So if you can’t find what you are looking for, just ask!

GAM, a U.S. company, is your complete source for robotic and servo gear reducers, rack & pinion systems, servo couplings, linear mounting kits, and other precision mechanical drive solutions used in automation technology.

With one of the largest product offerings in the motion control industry as well as the engineering expertise and manufacturing capabilities to develop customized solutions, GAM can help with your application.

U.S. manufacturing, being flexible to meet the needs of customer requests, and great service are what set us apart from the rest.
GAM Can.