ENGINEERING DOCUMENTATION

# High-Torque Hollow Shaft Gear Unit

Dimensional & Integration Guide

| DOCUMENT | REVISION / ISSUE | STATUS |
|---|---|---|
| DIG-ES-HG-S09-F20-R120 | DRAFT-08 / 26 Aug 2026 | Engineering Integration Reference |

## Integration Overview

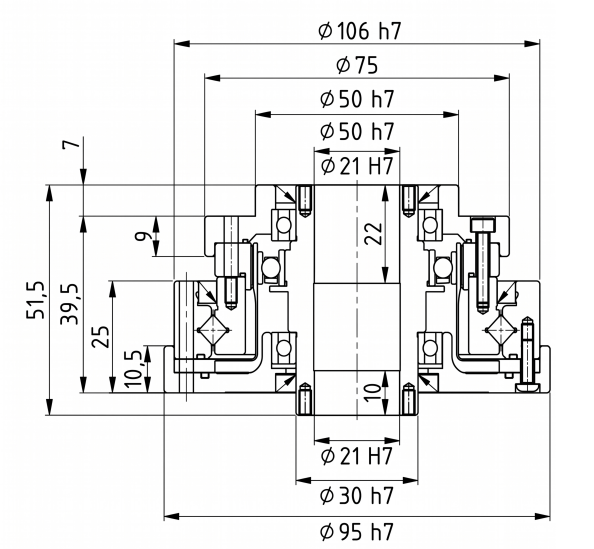
Hollow-shaft harmonic gear gear unit with integrated product interfaces for the selected configuration for compact, coaxial, high-ratio rotary axes. This guide supports host-interface design, wave-generator input integration, mounting alignment, load-cycle validation, torsional behavior, lubrication, sealing and commissioning for ES-HG-S09-F20-R120.

## Key Integration Facts

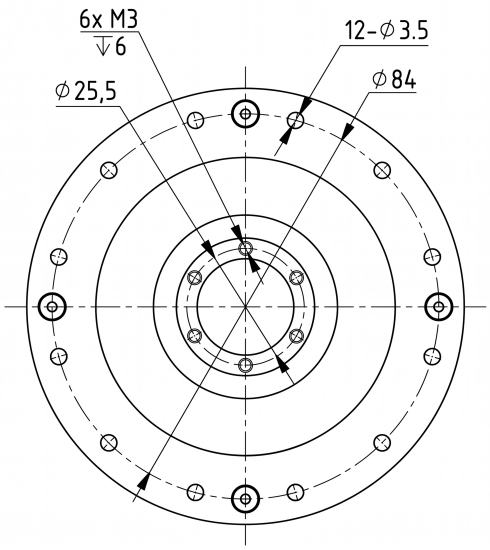
| INTEGRATION ITEM | PUBLISHED VALUE |
|---|---|
| Rated Torque | 52 N·m |
| Instantaneous Maximum Torque | 191 N·m |
| Start/Stop Peak Torque | 113 N·m |
| Reduction Ratio | 120 |
| Maximum Input Speed | 6500 r/min |
| Frame Size | 20 |
| Weight | 1.32 kg |

# Product Structure & Views

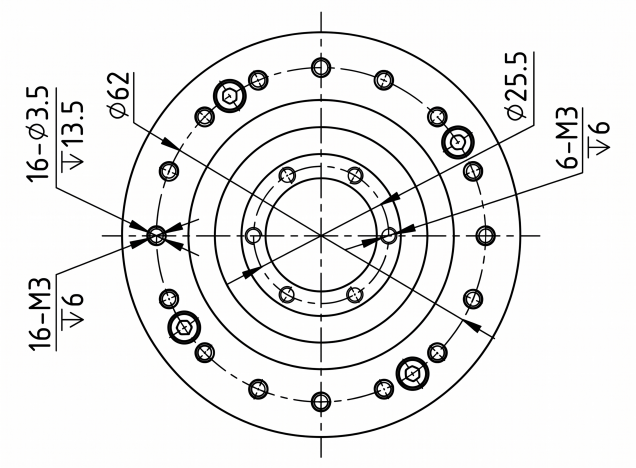
These views present the selected product structure, mounting interfaces and relevant integration geometry for this SKU.




Mechanical View 1




Mechanical View 2




Mechanical View 3

| VIEW | FIELD | VALUE |
|---|---|---|
| Mechanical View 1 | Maximum outer diameter | Φ106 h7 |
| | Intermediate diameter | Φ75 |
| | Shaft diameter 1 | Φ50 h7 |
| | Shaft diameter 2 | Φ50 h7 |
| | Mounting hole diameter 1 | Φ21 H7 |
| | Mounting hole diameter 2 | Φ21 H7 |
| | Lower shaft diameter | Φ30 h7 |
| | Lower end outer diameter | Φ95 h7 |
| | Vertical dimension 1 | 7 |
| | Vertical dimension 2 | 22 |
| | Vertical dimension 3 | 51.5 |
| | Vertical dimension 4 | 39.5 |
| | Vertical dimension 5 | 25 |
| | Vertical dimension 6 | 10.5 |
| | Vertical dimension 7 | 10 |
| | Feature dimension | 9 |
| Mechanical View 2 | Mounting threaded holes | 6x M3 threaded holes |
| | Surface finish depth | Surface finish depth 6 |
| | Through hole pattern | 12x Φ3.5 holes |
| | Outer circle diameter | Φ84 |
| | Bolt circle diameter | Φ25.5 |
| Mechanical View 3 | Center hole diameter | Φ25.5 |
| | Outer diameter | Φ62 |
| | Outer mounting holes | 16 holes × Φ3.5 |
| | Outer mounting holes pitch circle diameter | √13.5 (radial notation) |
| | Middle mounting holes | 6 holes × M3 D6 thread |
| | Inner mounting holes | 16 holes × M3 D6 thread |

## Overall Dimensions and Input Interface

| PARAMETER | PUBLISHED VALUE | UNIT |
|---|---|---|
| Frame Size | 20 | |
| Weight | 1.32 | kg |

- Confirm the selected series, frame size and ratio before using dimensions or interface geometry. Do not substitute a nearby frame or product form.
- Design the input shaft, key, effective engagement and axial retention to transmit the verified torque without uncontrolled wave-generator axial movement.
- Reserve assembly, sealing, inspection and removal access around the input, housing and output interfaces.

## Mounting, Alignment and Fastener Control

- Keep mounting faces flat, clean and free of burrs, raised holes, debris and coating buildup. Confirm reliefs and chamfers prevent interference.
- Seat the fixed and flexible gear members in the host structure before inserting the wave generator. Do not force engagement in a misaligned condition.
- Control concentricity, tilt and axial position of the input and housing datums. Insert the wave generator smoothly without excessive force on its bearing.
- Tighten fasteners in a staged diagonal sequence using the applicable torque and locking specification. Verify free, even rotation during assembly.

# Torque, Speed and Duty Boundaries

| PARAMETER | PUBLISHED VALUE | UNIT |
|---|---|---|
| Rated Torque | 52 | N·m |
| Allowable Average Torque | 64 | N·m |
| Start/Stop Peak Torque | 113 | N·m |
| Instantaneous Maximum Torque | 191 | N·m |
| Maximum Input Speed | 6500 | r/min |
| Average Input Speed | 3500 | r/min |
| Design Life | 15000 | h |

- Calculate average torque and average input speed from the complete acceleration, constant-speed, deceleration, dwell and reversal cycle.
- Treat start/stop peak and instantaneous maximum torque as transient boundaries. Do not use either value as a continuous operating point.
- Validate design life against actual torque, speed, shock frequency, lubrication, temperature, alignment and external loading.

### Published Torque, Speed and Life Boundaries

| PARAMETER | PUBLISHED VALUE | INTEGRATION REQUIREMENT |
|---|---|---|
| Rated Torque | 52 N·m | Use as the selected continuous output rating under validated duty and thermal conditions. |
| Allowable Average Torque | 64 N·m | Calculate the actual time-weighted output torque over the complete cycle. |
| Start/Stop Peak Torque | 113 N·m | Transient start/stop boundary; include acceleration and deceleration events. |
| Instantaneous Maximum Torque | 191 N·m | Short-duration shock boundary only; do not use as a normal operating point. |
| Maximum Input Speed | 6500 r/min | Maximum input-speed boundary; also verify motor and thermal limits. |
| Average Input Speed | 3500 r/min | Validate the time-weighted average input speed over the complete duty cycle. |
| Design Life | 15000 h | Design reference only; actual life depends on torque, speed, shock, lubrication and installation. |

# Transmission Accuracy and Torsional Rigidity

| PARAMETER | PUBLISHED VALUE | UNIT |
|---|---|---|
| Angle Transmission Accuracy | 1 | arcmin |
| Hysteresis Loss | 1 | arcmin |
| Torsional Rigidity K1 | 1.6 | ×10⁴N·m/rad |
| Torsional Rigidity K2 | 2.5 | ×10⁴N·m/rad |
| Torsional Rigidity K3 | 2.9 | ×10⁴N·m/rad |
| Torsional Rigidity T1 | 7 | N·m |
| Torsional Rigidity T2 | 25 | N·m |

- Installed positioning performance depends on reducer behavior, datum control, fastener distortion, motor and encoder errors, host stiffness and thermal growth.
- Use the published stiffness regions and transition torques when evaluating compliance, resonance, control gain and direction reversal.

### Published Accuracy and Torsional Rigidity Boundaries

| PARAMETER | PUBLISHED VALUE | INTEGRATION REQUIREMENT |
|---|---|---|
| Angle Transmission Accuracy | 1 arcmin | Installed system accuracy also depends on datum, encoder, motor and structural errors. |
| Hysteresis Loss | 1 arcmin | Include in direction-reversal and closed-loop positioning evaluation. |
| Torsional Rigidity K1 | 1.6 ×10⁴N·m/rad | Applies to the published low-torque stiffness region. |
| Torsional Rigidity K2 | 2.5 ×10⁴N·m/rad | Applies to the published intermediate stiffness region. |
| Torsional Rigidity K3 | 2.9 ×10⁴N·m/rad | Applies to the published upper stiffness region. |
| Torsional Rigidity T1 | 7 N·m | Published transition torque for stiffness-region interpretation. |
| Torsional Rigidity T2 | 25 N·m | Published transition torque for stiffness-region interpretation. |

## Lubrication, Sealing and Thermal Control

- Use only the current lubricant, fill method and quantity for the exact configuration. Do not mix incompatible lubricants.
- Provide compatible static and dynamic sealing at the input, output and housing interfaces without distorting the reducer or restricting motion.
- Validate lubricant distribution and temperature for the installed orientation, speed, load cycle and enclosure.
- Prevent chips, fibers, cleaning residue, moisture and other contamination from entering the gear or bearing cavities during assembly and service.

## Output Bearing and External Load Path

- Calculate radial, axial and moment loads at the output, including offset, acceleration, gravity, process force, impact and emergency-stop cases.
- Do not infer permissible external load from reducer torque capacity or frame size. Use applicable output-bearing data and safety criteria.
- Avoid forcing, impact, misalignment or host distortion through the output support bearing during installation and operation.

# Integration Checklist

| | |
|---|---|
| 01 | Confirm the drawing, published parameters and applicable assembly data identify this SKU. |
| 02 | Verify series, frame size, ratio, product form and input-interface dimensions. |
| 03 | Check mounting-face flatness, concentricity, tilt, chamfers, reliefs, cleanliness and support stiffness. |
| 04 | Verify input shaft, key, engagement length and axial wave-generator retention. |
| 05 | Assemble the fixed and flexible gear members before inserting the wave generator. |
| 06 | Use staged diagonal tightening and verify free, even rotation throughout assembly. |
| 07 | Calculate average, start/stop peak and shock torque over the complete operating cycle. |
| 08 | Validate average and maximum input speed, design life and installed thermal condition. |
| 09 | Evaluate backlash, angular accuracy, hysteresis and stiffness regions for the control system. |
| 10 | Confirm exact lubricant, fill quantity, orientation, sealing and contamination controls. |
| 11 | Validate output radial, axial and moment loads using applicable bearing data. |
| 12 | Include specified 2D, STEP, assembly, lubrication and bearing-load data in integration planning. |

**View SKU Product Datasheet** **Request controlled 2D drawing** **Request controlled STEP review** **Request a Quote**

## Engineering Use and Verification Notice

**01.** This Dimensional & Integration Guide applies only to EmbodyStack SKU ES-HG-S09-F20-R120 and is intended for dimensional evaluation and preliminary integration. It is not a applicable manufacturing drawing, reducer selection approval, bearing-load approval, lubrication specification, machinery risk assessment, safety validation or integration planning document and must not be used as the sole basis for machining, shaft or key manufacture, fastener selection, sealing, lubricant filling or final integration. Before design freeze, assembly or commissioning, verify all dimensions, datum geometry, fits, shaft and key interfaces, wave-generator retention, fastener engagement and tightening controls, torque and speed duty, shock cases, torsional accuracy and rigidity, external output loads, lubrication, sealing, temperature, contamination and maintenance requirements against the applicable EmbodyStack engineering data for this exact SKU. Where this guide and applicable product documentation differ, the applicable product documentation governs. Validate the complete reducer, motor, host structure, output load, motion cycle, guarding, fault cases and applicable regulatory requirements under intended operating conditions.