BRUSH MOTORS
The power of silence

MOTION

motors.crouzet.com
ABOUT CROUZET

The Motion product line provides innovative engineering expertise, high quality service and a complete offer of standard direct drives, geared motors and motion control solutions for applications where performance is key. Our ability to customize solutions as per virtually any customers’ request makes us the right partner to tackle the most demanding projects.

Crouzet is a brand of InnoVista Sensors™.

With a long-term commitment to technological excellence, the engineering teams have mastered the following core technologies and know-how:
› Electromagnetism
› Thermal dynamics
› Electromechanical systems
› Electronic drives

Covering the power range from 1 to 1000 W peak (1/100 to 1HP+) and available with spur, worm or planetary gearboxes, plus adapted controllers, our offer is specifically designed for access control systems, pumps and valves, railway applications, electrical equipment, medical equipment and the industry.

InnoVista Sensors™ is a worldwide industrial specialist of sensors, controllers and actuators for automated systems.

Through its brands, Crouzet and Systron Donner Inertial, InnoVista Sensors™ offers a wide range of reliable, efficient and customizable components dedicated to the Aerospace & Defense, Transportation and Industrial markets and segments.

Thanks to the recognized expertise of its teams and a strong innovation policy, InnoVista Sensors™ brings performance enhancing solutions to its customers worldwide.

InnoVista Sensors™: your trusted partner of choice to face industrial challenges of today and tomorrow.

www.innovistasensors.com
To meet market expectations and provide customers with the right solutions within the shortest timeframes, Crouzet has structured its processes around the different types of product available: standard products, adapted products or products specially developed for a customer. Introducing the adaptation wheel...

1  STANDARD PRODUCTS
   Sales service
   A full range of motors, geared motors and associated controllers. You can create your automation control applications as quickly as possible.

2  PRODUCTS WITH ADDED VALUE
   Customer Adaptation Centre
   All our standard products can have additional factory-mounted auxiliaries or accessories: connectors, leads, special terminals, customized shafts, adaptor plates, etc. Seamless integration in your equipment means you benefit from simpler logistics and optimum installation reliability.

3  ADAPTED PRODUCTS
   Customer Adaptation Centre
   Defined in coordination between your project teams and our specialists, these adapted products have exactly the right levels of performance and functionality you need for your applications.

4  SPECIAL PRODUCTS
   Engineers and teams
   Dedicated project
   From the very start of a project, Crouzet’s experts work closely with your teams to develop the specification. All our design, industrialization and approval expertise goes into developing Motion Control solutions that are tailored to your requirements.
With more than 50 years' experience, Crouzet, a specialist in customized Motion Solutions, presents its DCmind Brush range of direct current Brush motors.

Designed by the engineers in Crouzet, this range - the quietest on the market - is ideally suited to the medical, industrial and commercial equipment sectors.

**PRODUCT BENEFITS:**

- Exceptionally quiet: 35 dBA
- Service life up to 24,000 hours
- More than 80% efficiency
- Output power up to 104 W
- 12, 24, 48, 90 and 120 V ac power supplies and other voltages on request
- Up to IP69K
- Conformity to the specific standards for your market and required approvals

**EXCEPTIONALLY QUIET**

Systematic approach to eliminate noise
- At source
- From transmission
- From dispersion

Innovative design
- Choice of new materials
- Optimization of component assembly (centering, perpendicularity, parallelism, etc.)

A range of gearbox
- In line with high performance motor

**SERVICE LIFE UP TO 24,000 HOURS**

- Its average service life, in continuous duty, is between 24,000 hours at no-load and 5000 hours at rated load

**MORE THAN 80% EFFICIENCY**

High performance magnetic circuit
- Optimum magnetic flux
- Magnets designed to optimize the detent torque

Optimal electromagnetic performance
- Energy losses on the winding
- Magnetic losses
- Minimal friction

**EXCEPTIONAL PERFORMANCE EVEN IN SEVERE ENVIRONMENTS**

IP65 as standard
- Front and rear end caps redesigned to ensure a good seal, including wire exits
- IP 67 on request
- IP 69K on request

Approvals and conformities
- UL 1004 - CE - ROHS
- Medical (IEC 60601-1)
- Office automation (IEC 60950)
- Household appliances (IEC 60335)
Crouzet has been involved in eco-design for many years (ISO 14001 held since 1997).

Its production plants have some of the lowest existing impacts on the environment, and in addition, all Crouzet's product developments are constantly reducing their footprint on ecosystems.

The DCmind Brush motors range reduces this footprint to a third of more conventional manufacturing techniques.

**ECOLOGICAL FOOTPRINT ON NATURAL ENVIRONMENTS:**

Throughout a product's service life, from design through to the recycling stage, every manufactured product has an impact on ecosystems.

Reducing this footprint is a priority for any company that cares about the environment.

The diagram opposite compares the footprint of a conventional design with the new design.

Footprint usually left on ecological environments by standard industrial design motors.

The new Crouzet design's ecological footprint.

**NOISE LEVEL:**

A noise level comparable to the sound of the wind rustling in the trees...

- 150 dBA: Airplane taking off
- 140 dBA: Motor racing
- 130 dBA: Pain threshold
- 120 dBA: Thunder
- 110 dBA: Concert
- 100 dBA: Deep-drawing machine
- 90 dBA: Lazer cutting machine
- 80 dBA: Hi-Fi system
- 70 dBA: Ringing telephone
- 60 dBA: Office environment
- 50 dBA: Rain
- 40 dBA: Artificial respirator
- 30 dBA: Whispered conversation
- 20 dBA: Sound isolation booth
- 10 dBA: Audible limit
- 0 dBA: Audible limit
To complement the current range from Crouzet, the latest generation of DC Brush direct drive
and geared motors have been precision engineered to minimise all mechanical and electro-
mechanical variations.
Extremely quiet, this range is ideally suited to medical and laboratory applications.

### ACCESSORIES AND ADAPTATIONS
- Rear Friction Brake
- 1,000 Pulse 2-Channel Encoder
- Connectors
- Voltage, speed, power
- Shaft dimensions and material
- Motor length
- Other ratios and gearboxes
- Etc.

### NEW ADAPTATION POSSIBILITIES
- Railway application (compliance with fire/smoke regulations)
- Isolation for use at 230 V
- Other colours

### DCmind BRUSH: SELECTION GUIDE

<table>
<thead>
<tr>
<th>OUTPUT POWER (W)</th>
<th>NOMINAL TORQUE (mNm)</th>
<th>NOMINAL SPEED (rpm)</th>
<th>TYPE OF GEARBOX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>PLANETARY Ø 42</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PLANETARY Ø 52</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>90°</td>
</tr>
<tr>
<td>FAMILY</td>
<td>A1</td>
<td>B1</td>
<td>RAD10</td>
</tr>
<tr>
<td>MAX. TORQUE (Nm)</td>
<td>15</td>
<td>25</td>
<td>10</td>
</tr>
</tbody>
</table>

#### Ø 42 mm

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Nominal Torque (Nm)</th>
<th>Nominal Speed (rpm)</th>
<th>Encoder Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>89810</td>
<td>15</td>
<td>50</td>
<td>2920</td>
</tr>
<tr>
<td>89800</td>
<td>24</td>
<td>75</td>
<td>3100</td>
</tr>
<tr>
<td>89850</td>
<td>35</td>
<td>110</td>
<td>3000</td>
</tr>
</tbody>
</table>

#### Ø 63 mm

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Nominal Torque (Nm)</th>
<th>Nominal Speed (rpm)</th>
<th>Encoder Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>89830</td>
<td>57</td>
<td>180</td>
<td>3000</td>
</tr>
<tr>
<td>89890</td>
<td>104</td>
<td>290</td>
<td>3430</td>
</tr>
</tbody>
</table>

Motors 24 V:

- x = 1: IP65 | x = 5: brake | x = 9: encoder
- y = 0: IP65 | y = 5: brake | y = 9: encoder
DCmind: DC DIRECT-DRIVE BRUSH MOTORS

Ø 42 mm - 20 W

- Silent motor
- 12 V and 24 V built in EMC filter class B
- Excellent efficiency
- Long life
- IP65
- In accordance with UL - CE - ROHS regulations

Part numbers

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Type</th>
<th>12 V</th>
<th>24 V</th>
<th>48 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td></td>
<td>89810189810</td>
<td>89810189810</td>
<td>89810189810</td>
</tr>
<tr>
<td>Voltage</td>
<td></td>
<td>12 V</td>
<td>24 V</td>
<td>48 V</td>
</tr>
<tr>
<td>Option: IP65 level</td>
<td>89810007</td>
<td>89810007</td>
<td>89810007</td>
<td></td>
</tr>
<tr>
<td>Option: holding brake 0.25 Nm, 24 V</td>
<td>89810008</td>
<td>89810008</td>
<td>89810008</td>
<td></td>
</tr>
<tr>
<td>Option: 2 channels encoder 1000 pulses/revolution, 5 V</td>
<td>89810003</td>
<td>89810003</td>
<td>89810003</td>
<td></td>
</tr>
</tbody>
</table>

- Speed (rpm):
  - 4200
  - 4000
  - 4100

- Absorbed current (A):
  - 0.26
  - 0.11
  - 0.07

- Torque (mNm):
  - 50
  - 50
  - 50

- Output power (W):
  - 15
  - 15
  - 15

- Efficiency (%):
  - 82
  - 64
  - 51

- Insulation conforming to IEC60085:
  - Class E
  - Class E
  - Class E

- Noise level (dB):
  - 35
  - 35
  - 35

- Max. output power (W):
  - 158
  - 195
  - 195

- Starting current (A):
  - 6.1
  - 7.4
  - 7.4

- Resistance (Ω):
  - 2
  - 5
  - 2

- Power constant (mNm/A):
  - 7.5
  - 14
  - 14

- Duration (min):
  - 3
  - 3
  - 3

- Inertia (g.cm²):
  - 0.05
  - 0.06
  - 0.06

- Terminal dimensions (mm):
  - 2 x 200 mm AWG20
  - 2 x 2.75 at 120° depth 5 over Ø 32
  - 2 x ø 2.75 at 120° depth 5 over Ø 32

- Special output shaft
- Shaft with pinion, pulley, worm gear
- Special supply voltage
- Other wire length
- Optical or Hall effect encoder - 1 or 2 channels
- Specific motor mounting flange
- Specific motor connectors
- IP67, IP68K

Product made to order

Options

- Holding brake 0.25 Nm
- Encoder
DCmind: DC DIRECT-DRIVE BRUSH MOTORS

Ø 42 mm - 36 W

- Silent motor
- 12 V and 24 V built in EMC filter class B
- Excellent efficiency
- Long life
- IP66
- In accordance with UL - CE - ROHS regulations

**Part numbers**

<table>
<thead>
<tr>
<th>Type</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 V</td>
<td>898000</td>
</tr>
<tr>
<td>24 V</td>
<td>898000</td>
</tr>
<tr>
<td>48 V</td>
<td>898000</td>
</tr>
</tbody>
</table>

**No-load characteristics**

- Speed (rpm) 4000
- Rated current (A) 0.35

**Nominal characteristics**

- Speed (rpm) 3000
- Torque (Nm) 25
- Output power (W) 24
- Efficiency (%) 83

**General characteristics**

- INSULATION Class E
- Noise level (BDI) 30
- Mass output power (W) 0.1
- Starting torque (Nm) 0.3
- Starting current (A) 0.3
- Resistance (Ω) 2.2
- Insulation class 2
- Torque constant (Nm/Vmax) 2.5
- Electromagnetic field constant (mH)
- Mechanical time constant (ms) 17
- Phase (°C)
- Weight (kg) 0.4
- Commutator segments 8
- Service life (10^6) 500
- Wires size (mm²) 2.0

**Comments**

- IP66 level except for the output shaft. Encoder and brake options are IP67.

**Product adaptations, contact us**

- Special output shaft
- Shaft with pinion, pulley, worm gear
- Special supply voltage
- Other wire length
- Optical or Hall effect encoder - 1 or 2 channels
- Specific motor mounting flange
- Special motor connectors
- IP67, IP69K

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**Curves**

- **Speed (rpm)**
- **Current (A)**
- **Torque at nominal**
- **Torque at maximum efficiency**

**Dimensions (mm)**

- 3 x M3 at 180° depth 5 over Ø 32
- 2 x Ø 2.75 at 120° depth 5 over Ø 32

**Options**

- Holding brake 0.25 Nm

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**Product made to order**
DCmind: DC DIRECT-DRIVE BRUSH MOTORS

Ø 42 mm - 51 W

- Silent motor
- 12 V and 24 V built in EMC filter class B
- Excellent efficiency
- Long life
- IP65
- In accordance with UL - CE - ROHS regulations

**Part numbers**

<table>
<thead>
<tr>
<th>Type</th>
<th>Voltage</th>
<th>12 V</th>
<th>24 V</th>
<th>48 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option: IP65 level</td>
<td>89850007</td>
<td>89850008</td>
<td>89850009</td>
<td></td>
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<tr>
<td>Option: holding brake 0.25 Nm, 24 V</td>
<td>89850007</td>
<td>89850008</td>
<td>89850009</td>
<td></td>
</tr>
<tr>
<td>Option: 3 channels encoder 1000 pulses/revolution, 5 V</td>
<td>89850007</td>
<td>89850008</td>
<td>89850009</td>
<td></td>
</tr>
</tbody>
</table>

**No-load characteristics**

- **Speed (rpm)**
  - 4000
  - 7350
  - 3840

- **Torque (Nm)**
  - 1.3
  - 1.7
  - 2.1

- **Efficiency (%)**
  - 70
  - 76
  - 72

- **Insulation according to IEC60085**
  - Class E

- **Noise level (dBA)**
  - 35
  - 35
  - 35

- **Max. torque constant (Wm/A)**
  - 0.6
  - 0.6
  - 0.6

- **Starting torque (mNm)**
  - 420
  - 520
  - 500

- **Starting current (A)**
  - 6
  - 6
  - 6

- **Resistance (Ω)**
  - 1.9
  - 2
  - 2

- **Inductance (mH)**
  - 0.05
  - 0.05
  - 0.05

- **Torque constant (Nm/A)**
  - 0.5
  - 0.5
  - 0.5

- **Mechanical time constant (ms)**
  - 15
  - 14
  - 13

- **Wires (g/cm²)**
  - 150
  - 160
  - 180

- **Weight (g)**
  - 624
  - 820
  - 8400

- **Wire length (mm)**
  - 9000
  - 9000
  - 9000

- **Torsion (Nmm)**
  - 200
  - 200
  - 200

**Options**

- Special output shaft
- Shaft with pinion, pulley, worm gear
- Special supply voltage
- Other wire length
- Optical or Hall effect encoder - 1 or 2 channels
- Specific motor mounting flange
- Special motor connectors
- IP67, IP69K

**Dimensions (mm)**

- Ø38

**Product adaptations, contact us**

Product made to order
DCmind: DC DIRECT-DRIVE BRUSH MOTORS

Ø 63 mm - 102 W

- Silent motor
- 12 V and 24 V built in EMC filter class B
- Excellent efficiency
- Long life
- IP65
- In accordance with UL - CE - ROHS regulations

### Part numbers

<table>
<thead>
<tr>
<th>Type</th>
<th>Voltage 12 V</th>
<th>Voltage 24 V</th>
<th>Voltage 48 V</th>
<th>Voltage 90 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>8930</td>
<td>21903898</td>
<td>21503898</td>
<td>21003898</td>
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<tr>
<td>8930011</td>
<td>40903898</td>
<td>40503898</td>
<td>40003898</td>
<td></td>
</tr>
<tr>
<td>8930012</td>
<td>8983003890</td>
<td>8983003890</td>
<td>8983003890</td>
<td></td>
</tr>
</tbody>
</table>

### Specifications

- **Voltage**
  - Options: 12 V, 24 V, 48 V, 90 V
- **Speed (rpm)**
  - 3630
- **Rated current (A)**
  - 0.32
- **Torque (Nm)**
  - 3.7
- **Voltage (W)**
  - 14
- **Efficiency (%)**
  - 78

### General Characteristics

- Insulation class: E
- Protection grade: IP65
- Voltage: 12 V
- Starting current (A): 3.7
- Windage: 0.14
- Maximum torque (Nm): 3.7
- Service life (h): 5000
- Wear length (mm): 200
- Ball bearing: ✓

### Options

- Special output shaft
- Shaft with pinion, pulley, worm gear
- Special supply voltage
- Other wire length
- Optical or Hall effect encoder - 1 or 2 channels
- Specific motor mounting flange
- Specific motor connectors
- IP65, IP69K

### Product adaptations, contact us

Product made to order
DCmind: DC DIRECT-DRIVE BRUSH MOTORS
Ø 63 mm - 209 W

- Silent motor
- 24 V built in EMC filter class B
- Excellent efficiency
- Long life
- IP65
- In accordance with UL - CE - ROHS regulations

### Part numbers

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Type</th>
<th>Part Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 V</td>
<td>89890</td>
<td>89890011 89890011 89890003</td>
</tr>
<tr>
<td>48 V</td>
<td>89890</td>
<td>89890003 89890004 89890005</td>
</tr>
<tr>
<td>90 V</td>
<td>89890</td>
<td>89890003 89890004 89890005</td>
</tr>
<tr>
<td>120 V</td>
<td>89890</td>
<td>89890003 89890004 89890005</td>
</tr>
</tbody>
</table>

### Specifications

- **Silent motor**
- 24 V built in EMC filter class B
- Excellent efficiency
- Long life
- IP65
- In accordance with UL - CE - ROHS regulations

### Part numbers

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Type</th>
<th>Part Numbers</th>
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<tr>
<td>24 V</td>
<td>89890</td>
<td>89890011 89890011 89890003</td>
</tr>
<tr>
<td>48 V</td>
<td>89890</td>
<td>89890003 89890004 89890005</td>
</tr>
<tr>
<td>90 V</td>
<td>89890</td>
<td>89890003 89890004 89890005</td>
</tr>
<tr>
<td>120 V</td>
<td>89890</td>
<td>89890003 89890004 89890005</td>
</tr>
</tbody>
</table>

### Options

- **Holding brake 0.5 Nm**
- **Encoder**

### Product adaptations, contact us

- Special output shaft
- Shaft with pinion, pulley, worm gear
- Special supply voltage
- Other wire length
- Optical or Hall effect encoder - 1 or 2 channels
- Specific motor mounting flange
- Special motor connectors
- IP67, IP68K

### Dimensions (mm)

- 4 x M5 at 90° depth 10 over Ø 40
- 4 x M5 at 90° depth 8 over Ø 40

### Curves

- Speed (rpm) vs. Current (A)
- Speed (rpm) vs. Torque at nominal
- Speed (rpm) vs. Torque at maximum efficiency

### Encoder

- Optical or Hall effect encoder - 1 or 2 channels
GEARBOXES FOR DCmind BRUSH RANGE

3 to 25 Nm

- Planetary and worm gearboxes, very silent versions
- Shafts on ball bearings
- Long service life

General characteristics

<table>
<thead>
<tr>
<th>Number of stages</th>
<th>Maximum permitted torque (Nm)</th>
<th>Efficiency</th>
<th>Axial dynamic load (daN)</th>
<th>Radial dynamic load (daN)</th>
<th>Weight (kg)</th>
<th>Standard reduction ratios</th>
<th>Operating temperature</th>
<th>Typical noise level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>0.8</td>
<td>16</td>
<td>23</td>
<td>0.3</td>
<td>98 - 137 - 222 - 399</td>
<td>-30 to +75°C</td>
<td>45dBA</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td>0.8</td>
<td>32</td>
<td>33</td>
<td>0.8</td>
<td>98 - 137 - 195 - 322 - 499</td>
<td>-10 to +100</td>
<td>45dBA</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>0.75</td>
<td>45</td>
<td>31</td>
<td>0.9</td>
<td>98 - 137 - 195 - 322 - 499</td>
<td>-10 to +100</td>
<td>45dBA</td>
</tr>
</tbody>
</table>

Planetary gearboxes:

- To maintain a very low noise level, the motor pinion is precision machined on motor shaft to obtain optimum concentricity and parallelism.
- The gears in the first stage are helical-cut and made from a composite material. This design significantly improves gear life by reducing wear due to friction, increasing gearbox efficiency and ensures a very low noise level even with the gearbox under load.

Worm gearboxes:

- This gearbox combines a tempered steel worm gear with a hardened bronze helical wheel, a combination that ensures a long service life. The helical wheel rotates in a grease reservoir to provide an excellent slip coefficient and dissipate heat. O-rings and lip seals equipped with garter springs are used to ensure sealing the gearbox output shaft.
- The gearbox casing is made of aluminium to maximize heat dissipation.
- However, because of the high power rating of this gearbox and the lower efficiency inherent in ratio worm gearboxes, care must be taken not to exceed a temperature of 75°C on the gearbox casing during operation.
- The output shaft configuration can be right, left, or a dual shaft (shaft output on both sides).

Part numbers

<table>
<thead>
<tr>
<th>Family</th>
<th>Type of gearbox</th>
<th>Planetary ø 42</th>
<th>Planetary ø 52</th>
<th>Worm gear</th>
<th>Planetary ø 42</th>
<th>Planetary ø 52</th>
<th>Worm gear</th>
</tr>
</thead>
</table>

Product adaptations, contact us

- Special shafts
- Other reduction ratios
- Other fixing holes
- Special mounting flange

Dimensions (mm)

Planetary gearbox ø 42 type A1

Planetary gearbox ø 52 type B1

Worm gearbox RAD10

The left-hand and right-hand sides of the gearbox are identical.
DCmind: DC BRUSH GEARMOTORS

Dimensions (mm)

8981A1
L: 1 stage: 119.9 max.
L: 2 stages: 133 max.
L: 3 stages: 146.1 max.

8983A1
L: 1 stage: 135 max.
L: 2 stages: 148.1 max.
L: 3 stages: 161.2 max.

8985A1
L: 1 stage: 161.1 max.
L: 2 stages: 174.2 max.
L: 3 stages: 187.3 max.

8983B1
L: 1 stage: 159.1 max.
L: 2 stages: 173 max.
L: 3 stages: 187.3 max.

8980B1
L: 1 stage: 135 max.
L: 2 stages: 148.1 max.
L: 3 stages: 161.2 max.

8985B1
L: 1 stage: 161.1 max.
L: 2 stages: 174.2 max.
L: 3 stages: 187.3 max.

8980A1
L: 1 stage: 119.9 max.
L: 2 stages: 133 max.
L: 3 stages: 146.1 max.

8985A1
L: 1 stage: 161.1 max.
L: 2 stages: 174.2 max.
L: 3 stages: 187.3 max.

8983B1
L: 1 stage: 159.1 max.
L: 2 stages: 173 max.
L: 3 stages: 187.3 max.

8980A1
L: 1 stage: 119.9 max.
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8985A1
L: 1 stage: 161.1 max.
L: 2 stages: 174.2 max.
L: 3 stages: 187.3 max.

8983B1
L: 1 stage: 159.1 max.
L: 2 stages: 173 max.
L: 3 stages: 187.3 max.

8980A1
L: 1 stage: 119.9 max.
L: 2 stages: 133 max.
L: 3 stages: 146.1 max.

8985A1
L: 1 stage: 161.1 max.
L: 2 stages: 174.2 max.
L: 3 stages: 187.3 max.

8983B1
L: 1 stage: 159.1 max.
L: 2 stages: 173 max.
L: 3 stages: 187.3 max.

8980A1
L: 1 stage: 119.9 max.
L: 2 stages: 133 max.
L: 3 stages: 146.1 max.

8985A1
L: 1 stage: 161.1 max.
L: 2 stages: 174.2 max.
L: 3 stages: 187.3 max.

8983B1
L: 1 stage: 159.1 max.
L: 2 stages: 173 max.
L: 3 stages: 187.3 max.

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L: 1 stage: 119.9 max.
L: 2 stages: 133 max.
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