INDUCTION HOBS G4

Electrolux
Induction Hobs G4

- Induction hobs of the “4th generation”
- Modular construction:
  - “intelligent” filter module
  - power (“inverter”) module for 2 induction cooking zones
    (2 modules on 4-zone induction hobs, 1 module on Domino hobs or mixed hobs)
  - individual Induction coils with temperature sensors
  - fan module
  - on independent hobs: HIC touch-control user interface
Components

- Coils with temperature sensors
- Touch-control user interface with carrier
- Cover
- Coil carrier
- Complete induction generator in plastic tray, with mains terminal block
- Filter module
- Fan
- L.H. power module with heat sink
- R.H. power module with heat sink

Electrolux
Service
Induction Generator
Connections

1. LT 1
2. Filter
3. LT 2
4. User Interface

2 x 3.7 kW

MacsBus
Linbus
Linbus
Wiring
System Description

- Filter module consists of:
  - EMC filter
  - Microcontroller - controls function, and communication with user interface, with power board & fan
  - Flash EEPROM - stores software version, configuration data for all modules, appliance status, etc

- Power modules and user interface are identical for all models (because configuration data is on filter module)

- Heat sinks on power modules - if 2 modules are used, the heat sinks are clamped together
Possible Cooking Zones

- Ø 145 mm, 1200 W, Power function 1500 W
- Ø 180 mm, 1800 W, Power function 2300 W
- Ø 210 mm, 2200 W, Power function 3000 W
- Ø 260 mm, 2400 W, Power function 3200 W
Cooking Zone Combinations

1 power module ( max. 3,7 kW ) can drive the following combinations of cooking zones:

- 1 x ∅ 180 mm + 1 x ∅ 145 mm
- 2 x ∅ 180 mm
- 1 x ∅ 210 mm + 1 x ∅ 145 mm
- 1 x ∅ 260 mm + 1 x ∅ 145 mm
Cooking Zone Combinations

Dependent and independent hobs in the following configurations:

- 4 induction zones, using 2 power modules; total power of coils associated to one module must not exceed 3.7 kW (coils can be arranged crosswise or left-right)
- Domino hobs with 2 induction zones, 1 power module
- Mixed hobs with 2 induction zones + 2 radiant zones, 1 power module
Building-in of hobs with more than 60 cm width

- Cut-out required only in working plate
- Base tray always fits in standard 60 cm cabinet

Diagram:

- Hob width > 60 cm
- Furniture width > 60 cm
- Vitroceramic plate
- Coil
- Coil carrier
- Base tray
- Heat sink
- Furniture sidewalls
Power Control

... for conventional cooking zone

Time

ON  OFF

mean power

100 %

Power Control

April 2004

ESSE-N /A.S.
Anm: power control possible down to approx. 300-400 W
Lower powers obtained by switching these 400 W at short intervals (approx. 2 sec)

... induction cooking zone
### Kochstufen

<table>
<thead>
<tr>
<th></th>
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<td>-</td>
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<td>-</td>
<td>-</td>
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<tr>
<td>4</td>
<td>1</td>
<td>2,5%</td>
<td>30</td>
<td>45</td>
<td>55</td>
<td>60</td>
<td>-</td>
<td>0,5</td>
<td>6 h</td>
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<tr>
<td>4.1</td>
<td>2</td>
<td>3,0%</td>
<td>36</td>
<td>54</td>
<td>66</td>
<td>72</td>
<td>0,2</td>
<td>1</td>
<td>6 h</td>
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<tr>
<td>4.2</td>
<td>8</td>
<td>5,5%</td>
<td>66</td>
<td>99</td>
<td>121</td>
<td>132</td>
<td>0,2</td>
<td>1,7</td>
<td>6 h</td>
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<td>4.3</td>
<td>11</td>
<td>8,0%</td>
<td>96</td>
<td>144</td>
<td>176</td>
<td>192</td>
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<td>6 h</td>
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<td>5</td>
<td>12</td>
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<td>126</td>
<td>189</td>
<td>231</td>
<td>252</td>
<td>3,12</td>
<td>4,8</td>
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<td>5.1</td>
<td>14</td>
<td>13,0%</td>
<td>156</td>
<td>234</td>
<td>286</td>
<td>312</td>
<td>4,4</td>
<td>5,5</td>
<td>5 h</td>
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<td>5.2</td>
<td>15</td>
<td>15,5%</td>
<td>186</td>
<td>279</td>
<td>341</td>
<td>372</td>
<td>5,85</td>
<td>6,5</td>
<td>5 h</td>
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<tr>
<td>5.3</td>
<td>16</td>
<td>18,0%</td>
<td>216</td>
<td>324</td>
<td>396</td>
<td>432</td>
<td>8,2</td>
<td>8,2</td>
<td>5 h</td>
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<tr>
<td>5.4</td>
<td>17</td>
<td>21,0%</td>
<td>252</td>
<td>378</td>
<td>462</td>
<td>504</td>
<td>10,2</td>
<td>10,2</td>
<td>4 h</td>
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<tr>
<td>6</td>
<td>18</td>
<td>25,0%</td>
<td>300</td>
<td>450</td>
<td>550</td>
<td>600</td>
<td>10,6</td>
<td>12,3</td>
<td>4 h</td>
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<td>6.1</td>
<td>19</td>
<td>31,0%</td>
<td>372</td>
<td>558</td>
<td>682</td>
<td>744</td>
<td>1,4</td>
<td>2</td>
<td>1,5 h</td>
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<td>20</td>
<td>38,0%</td>
<td>456</td>
<td>684</td>
<td>836</td>
<td>912</td>
<td>2,02</td>
<td>2,5</td>
<td>1,5 h</td>
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<td>21</td>
<td>45,0%</td>
<td>540</td>
<td>810</td>
<td>990</td>
<td>1080</td>
<td>2,46</td>
<td>3,5</td>
<td>1,5 h</td>
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<td>6.4</td>
<td>22</td>
<td>64,0%</td>
<td>768</td>
<td>1152</td>
<td>1408</td>
<td>1536</td>
<td>2,87</td>
<td>4,5</td>
<td>1,5 h</td>
</tr>
<tr>
<td>9</td>
<td>23</td>
<td>100,0%</td>
<td>1200</td>
<td>1800</td>
<td>2200</td>
<td>2400</td>
<td>--</td>
<td>--</td>
<td>1,5 h</td>
</tr>
<tr>
<td>9.1</td>
<td>24</td>
<td>125-136%</td>
<td>1500</td>
<td>2300</td>
<td>3000</td>
<td>3200</td>
<td>--</td>
<td>--</td>
<td>10 min</td>
</tr>
</tbody>
</table>
Booster

- Automatic booster A: if a cooking level from 1 to 8 is selected, the cooking zone is operated at full rated power for a defined initial period of time (see table on previous slide)
- After this time, the cooking zone is switched back to the selected level
- Booster time at levels 1 - 5. is long → for boiling water
- Booster time at levels 6 - 8 is short → for frying
Power Level

- Power level $P$: for a short time of maximum 10 minutes, the power can be increased to approx. 130% of the rated power.
- If required, power of the other cooking zone fed by the same power module will be reduced, so that a total power of 3.7 kW is not exceeded.
- On G4 it is possible to have the power function on all zones.
- Power level is automatically switched back to level 9 (after 10 minutes or if temperature at coil sensor exceeds 240°C or in case of heat sink overheating).
# Time-controlled Safety Switch-off

<table>
<thead>
<tr>
<th>Power level</th>
<th>Switch-off after</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 2.</td>
<td>6 hours</td>
</tr>
<tr>
<td>3 - 4</td>
<td>5 hours</td>
</tr>
<tr>
<td>4 - 5</td>
<td>4 hours</td>
</tr>
<tr>
<td>6 - 9</td>
<td>1.5 hours</td>
</tr>
</tbody>
</table>
Temperature Sensor

- Platinum sensor:
  ca. 1000 Ω at 25°C, increasing by 3.3 Ω per °C,
  (slightly different from a standard Pt1000)

- Separate spares kit not available on G4, because coils are now separate spares
Characteristic of Temperature Sensor

<table>
<thead>
<tr>
<th>Resistance (Ω)</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>900</td>
<td>0</td>
</tr>
<tr>
<td>2000</td>
<td>300</td>
</tr>
</tbody>
</table>

The graph above shows the characteristic of a temperature sensor, with resistance in ohms (Ω) plotted against temperature in degrees Celsius (°C). The resistance increases linearly with temperature.
Temperature at Coil Sensor

If temperature at coil sensor exceeds a defined threshold:

- power will be reduced temporarily without showing this to the user
- power can be even cut off completely (at approx. 280°C); this will be shown to the user with "-"
  - manual reset by the user required in this case
  - cut-off temperature in pot bottom depends very much on pot characteristics!
Ventilation

- minimum 5 mm gap for air outlet between worktop and oven
- ensure air inlet behind oven from below
Ventilation → Effect on Power

- Lower air inlet temperature = better performance
- Air inlet temperature shall not exceed 60°C

❌ if unventilated oven is built in under an induction hob, or if the oven (even ventilated) is working at 250°C for a longer time
→ the performance of the induction hob will deteriorate
Fan

- Fan is driven by software, taking into consideration temperature measured by an NTC sensor on heat sink

- 2 speeds
  - If temperature on heat sink about 50°C or cooking level > 0 → fan ON at low speed
  - If temperature on heat sink increases → fan ON at high speed
  - If heat sink cooled down below about 45°C and cooking level = 0 → fan OFF
Temperature at Heat-Sink Sensor

If temperature at heat-sink sensor exceeds a defined threshold:

- power will be reduced temporarily without showing this to the user
- power can be even cut off completely (at approx. 85-90°C); this will be shown to the user with "-"
  → manual reset NOT required in this case
**HIC Touch-Control User Interface**

- Independent hobs use the HIC touch-control user interface, with some specific modifications.
- Touch control function based on *infrared reflexion*.
HIC Hardware Configuration for Induction G4 (incl. mixed hobs)

- POWER function on induction zones
- 2-zone switch on radiant zones

- The same hardware configuration (same spare part number) is used on all independent full-induction or mixed hobs
- Model-specific software configuration is on filter module
Anzeigen in den Displays der Kochzonen

1 - 9  main cooking levels
2. - 6. intermediate cooking levels (some AEG models only)
\( u \)  keep-warm level
\( R \)  automatic booster
\( P \)  Power level
\( E \)  fault condition
\( F \)  *flashing*: no pot / wrong pot detected
\( - \)  safety cut-off (either time limit, or maximum temperature on coil or heat sink, exceeded)
\( H \)  residual-heat indication
\( L \)  lock (key lock or child lock)
Connect to Mains Supply

- Connect appliance to mains supply in accordance with instruction
- Switch on supply voltage
- After about 4 sec, initialization will be completed, and a beep will sound
- Switch on appliance only after this beep!
ON/OFF

- Touch ON/OFF for about 2 sec
- If neither a cooking zone nor the timer will be activated within the next 10 sec, the hob will be switched off automatically
- If permanent touch is detected (more than 10 sec, e.g. from object on touch zones) 5 beeps will sound first, then the hob will be switched off automatically
- For manual switch-off, touch ON/OFF for about 1 sec
Stop & Go / Keep Warm

- When touching the „Stop & Go“ symbol (L.H. of timer), the hob will switch to keep-warm level $u$ on all active zones.
- At next touch, the hob will revert to the previous settings.
Key Lock (Function Lock)

- After selecting the desired cooking levels and timer settings, touch the „Key“ symbol (R.H. of timer) to prevent inadvertent change.
- Displays show L for a short time, then the selected levels.
- All touch zones are inactive, except ON/OFF and „Key“.
- Whenever another zone is touched, L is shown for a short time.
- To unlock touch „Key“ again, or switch off the hob.
Child Lock

- Switch on hob, DON’T select any cooking level or timer
- touch the „Key“ symbol for about 3 sec, until beep sounds
- Touch one of the + symbols → displays show L, hob is switched off
- To de-activate: same sequence, but with one of the -
- To use hob once: simultaneously touch + and - of one cooking zone for about 1 sec, until beep sounds
Select cooking zone by repeatedly touching the timer symbol → selected zone is shown by the position of the flashing dot

Set time with + or - of the selected zone

If cooking level set → timer will work as automatic switch-off

If no cooking level set → timer will work as minute minder
Residual-Heat Indication

- Temperature-controlled via coils sensor: 65°C on, 60°C off
- No residual-heat indication when zone heated from external source (see next slide)
Stand-by Mode

- Coil temperature detection is de-activated
- Fan de-activated
- Temperature detection not activated if coil receives heat from outside (e.g. hot pot on zone which is not active) → there will be no residual heat indication in this case (N.B.: this was different on G3)
If a fault condition exists, the code will be shown flashing for 10 sec in the timer display; then a series of beeps, and the hob will be switched off.

If hob switched on again, full code not shown, but displays of affected zones show E.

The other zones remain active (if possible in the particular fault condition).

To show the full code again, disconnect and then reconnect mains voltage.

Alarm memory for last 5 faults.
Fault Conditions

**E0** configuration fault for filter PCB

**E3** very low supply voltage < 180 V - or - wrong connection to 400 V (shown for the first 10 sec)

**E4** coil temperature sensor outside of working range

**E5** one phase missing **

**E6** communication fault filter PCB - power module

**E7** heat sink temperature sensor outside of working range

**E8** communication fault filter PCB - user interface

**E9** configuration fault for user interface on filter PCB

** this - or any other - alarm code can’t be shown if the phase supplying the filter PCB is missing**
Demo Mode / Self Test / Alarm Memory

- Touch ON/OFF, and keep touched, until hob is switched off again - no beep
- Simultaneously touch + and - of both forward zones (4 fingers) - short beep - , keep touched for about 3 sec - short beep again
- Touch TIMER
- Timer display shows d
- One of the 3 functions above can now be selected
Demo Mode

- Activate: when timer display shows \( d \), touch + of one cooking zone → a dot is shown in the display (\( d \)).
- Hob is switched off
- All functions of the user interface can be simulated without heating
- De-activate with same sequence
- Demo Mode remains active if mains supply is disconnected
Self Test

- When timer display shows $d$, touch TIMER, display shows $S$
- Touch $+$ of one cooking zone
  → automatic self test starts:
    - All LEDs on for 10 sec
    - UI software version shown in timer display
    - Filter PCB software version in timer display
- At the end of this automatic sequence a beep sounds, hob is switched off
Alarm Memory
(Alarm Mode « E »)

- When timer display shows \( d \), touch TIMER twice, display shows \( E \)
- Touch + of one cooking zone
- The last 5 alarms are shown for 5 sec each, starting with the oldest one
- Beep sounds, hob is switched off
Spare Parts

- Filter module - one basic hardware, which has to be configured for the specific model (in first phase only in Rothenburg warehouse); procedure and part numbering similar as with EWM1000
- Only 1 spare part number for power module - can be used in all models
- Coils with incorporated temperature sensors
- Fan
- For independent hobs: HIC user interface - 1 spare part number for all full-induction and mixed hobs
- Plastic base tray
- Wiring
Suitable Pots and Pans

- Enamelled steel
- Aluminium with ferromagnetic bottom
- Stainless steel with ferromagnetic bottom
- Cast iron
Unsuitable Pots and Pans

- Aluminium
- Copper
- Non-ferromagnetic stainless steel
- Glass
- Ceramic materials
Pot Detection – Minimum Pot Sizes

<table>
<thead>
<tr>
<th>Nominal diameter of cooking zone</th>
<th>Ø 145 mm</th>
<th>Ø 180 mm</th>
<th>Ø 210 mm</th>
<th>Ø 260 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum pot diameter in user instruction</td>
<td>125 mm</td>
<td>145 mm</td>
<td>180 mm</td>
<td>180 mm</td>
</tr>
<tr>
<td>Minimum pot diameter, calibrated with steel plate</td>
<td>100 mm</td>
<td>120 mm</td>
<td>140 mm</td>
<td>180 mm</td>
</tr>
</tbody>
</table>

N.B. Actual minimum diameters have been reduced on G4. This should minimize the number of calls caused by this problem.
Pot Detection – Critical Points

Critical dimension is:

- Diameter of the pot bottom, not the outer diameter!

- For sandwich bottoms (e.g. ferromagnetic disc integrated in an aluminium pot bottom), the diameter of this disc is important
  - this diameter can be much smaller
    (e.g. some pots from Tefal)
Pot Detection – Critical Points

- Magnetic field decreases with distance from coil to magnetic bottom

→ far less power dissipation in the pot!
Pot Detection – Critical Points

Possible causes:

- Vitroceramic plate not pressed on coils
  (but: situation generally improved on G4 because of new coil carrier)

- Pot bottom not flat

- Enamelled & sandwich pot bottoms:
  larger vertical distance to ferro-magnetic insert
Pot Detection – Critical Points

- Excentric position of the pot
  → less coil windings covered

- Pot noises with some sandwich bottoms
  → it’s only possible to exchange the pot