RC-E discrete IGBTs for induction cooking
October 2016
Agenda

1. Learning objectives
2. Induction cooking market and portfolio
3. Introduction to RC-E – product overview and technical basics
4. Product positioning
5. Summary and additional information
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Learning objectives

› What is the RC-E family?
› What applications was it designed for?
› What are the key features?
› Where can I find more information?
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Induction cooking appliances
State of the market

- Consumer demand for table top induction cookers, multi-hob stoves, and induction rice cookers driven by:
  - Convenience – easy cooking and clean-up
  - Safety
  - Lower market prices
  - Range of features – faster cooking times, slim form factors, Wi-Fi enabled
  - Energy efficiency

- Induction cooking appliances vary in power, efficiency and price
  - Commonly 1200 W up to 2100 W
  - China energy efficiency standards - Class 1, 2, 3

- IGBTs are the key component for driving the induction coil
Design considerations for induction cooking appliances

- Most common topologies
  - Half-bridge: Uses 2x 600 V-650 V IGBTs
  - Single switch or SEPR (Single Ended Parallel Resonant): Uses 1x 1200 V+ IGBT
- SEPR used for table top cookers and induction rice cookers
  - Can also be used in multi-hob stoves and inverter microwave ovens

- Design requirements for IGBTs:
  - Freewheeling diode
  - Common switching frequencies from 20 kHz-30 kHz
  - Low switching and conduction losses
  - High reliability under variety of conditions
  - Competitive market price
RC IGBTs nomenclature

Grp 2: Device type
I: Single IGBT
H: Reverse conducting
K: DuoPack

Grp 3: Package
P: TO-220
W: TO-247-3
Z: TO-247-4

Grp 4: Nominal current
[μA] at 100°C

Grp 5: Tech class
N: N-channel
P: P-channel

Grp 6: Nominal voltage
[V] /10

Grp 7: Diode (for DuoPack only)
B: Emitter controlled half rated
C: Emitter controlled full rated
D: Rapid1 half rated
E: Rapid1 full rated
M: Rapid2 half rated
N: Rapid2 full rated
R: SiC 5th Gen half rated
S: SiC 5th Gen full rated

Grp 8: Optimization (examples, not complete list)
TP: TRENCHSTOP™ Performance
F5: Fast 5
H5: HighSpeed 5
R5: RC Next Gen
R3: RC 3rd Gen
R2: RC 2nd Gen
E1: RC-E series

Note: Not used for reverse conducting devices = blank
1200 V + RC IGBT portfolio
Induction cooking appliances

Table top cookers, multi-hob stoves, induction rice cookers, inverterized microwave ovens, other resonant applications

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<tr>
<th>Continuous collector current at $T_c = 100^\circ C$</th>
<th>1200 V</th>
<th>1350 V</th>
<th>1600 V</th>
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Active & preferred
New!
## Agenda

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New RC-E discrete IGBTs for induction cooking appliances

› RC-E: Economical, efficient and easy to design-in

› Reverse conducting discrete IGBT family

› Designed specifically for the soft switching requirements of induction cookers

› Optimized to be the most cost effective solution for low to mid range cookers
  
  – Offered in 15 A, 1200 V, most commonly used in 1500 W – 1800 W, Class 2 table top cookers
  
  – Also available in 25 A, 1200 V
  
  – Standard TO-247 package for simple replacement in existing designs

› Based on the technology used in the worldwide #1 discrete IGBT family, RC-H
Reverse conducting IGBTs Overview

› Technology concept

› Free-wheeling diode monolithically integrated with IGBT chip
  - Same DC current rating of diode and IGBT
  - **RC-Drives/Drives Fast** family: Supports hard switching and SC rated for home appliance drives
  - **RC-H** families: Performance leadership in resonant topologies
  - New **RC-E** family: Optimized for best price-performance in soft switching applications like induction cookers
RC-E performance overview
IHW15N120E1

- Optimized for soft switching applications, such as low to mid power range induction cookers
  - Similar system performance to best-in-class RC-H3 across wide power range
  - Low switching and conduction losses
  - Supports most common blocking voltage: 1200 V
  - Optimized for performance with switching frequencies from 18 kHz-40 KHz

- Key benefits
  - Reduced system cost
  - Helps to meet energy efficiency standards with low losses
  - Drop-in replacement for existing designs
  - Proven technology from the industry leader

Soft switching Trade-off
I_c = 15 A, T_c = 25°C, R_G = 10 Ω, V_{GE} = 18 V

\[ E_{off} \] vs. \[ V_{CE(sat)} \] [V]

- IHW15N120E1
- IHW15N120R3
- Competitor 1
- Competitor 2
- Competitor 3
RC-E

Soft switching leadership in price-performance

IGBT Power Losses
IHW15N120E1 vs. Competitors
Normal cooktop operation, Tamb = 25C

- IHW15N120E1
- IHW15N120R3
- Competitor 4
- Competitor 3
- Competitor 2
- Competitor 1

Optimized for best price-performance trade off in 1500-1800 W cookers
**1200 V + discrete IGBT families for induction cooking**

<table>
<thead>
<tr>
<th>IGBT Family</th>
<th>Value</th>
<th>Application focus</th>
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<tr>
<td><strong>E1</strong></td>
<td></td>
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</table>
|             | Best price-performance value | Low to mid power range table top cookers and stoves, induction rice cookers  
|             |                   | Designs using requiring 1200 V blocking voltage |
| **R2**      | Highest blocking voltage available, 1600 V | Induction rice cookers, inverter microwave ovens, multi-hob stoves  
|             |                   | Designs which require high overvoltage margin |
| **R3**      | Good performance in a broad range of frequencies and power ranges | Induction rice cookers, inverter microwave ovens, multi-hob stoves  
|             |                   | Higher power designs needing 30 A, 40 A devices |
| **R5**      | Best performance at switching frequencies $>20\text{ kHz}$, Lowest losses for highest efficiency | Table top cookers and multi-hob stoves  
|             |                   | Designs with higher switching frequencies |
## Extended RC IGBT Portfolio for Induction Cooking Appliances

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<thead>
<tr>
<th>$I_c$ nom [A]</th>
<th>$650$ V</th>
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<tbody>
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<td>R5</td>
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<td>IR(S)218xx</td>
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<td>IRS44273L</td>
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**NEW!**

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Summary

› RC-E is a new family of reverse conduction discrete IGBTs
  – Specifically designs for soft switching applications, like induction heating
› Optimized for best price-performance
  – Low losses at competitive prices
› Available in 15 A and 25 A, 1200 V in standard TO-247
  – Drop-in replacement for existing designs
# Support material

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<td>- Presentation</td>
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- [www.infineon.com/rc-e](http://www.infineon.com/rc-e)
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