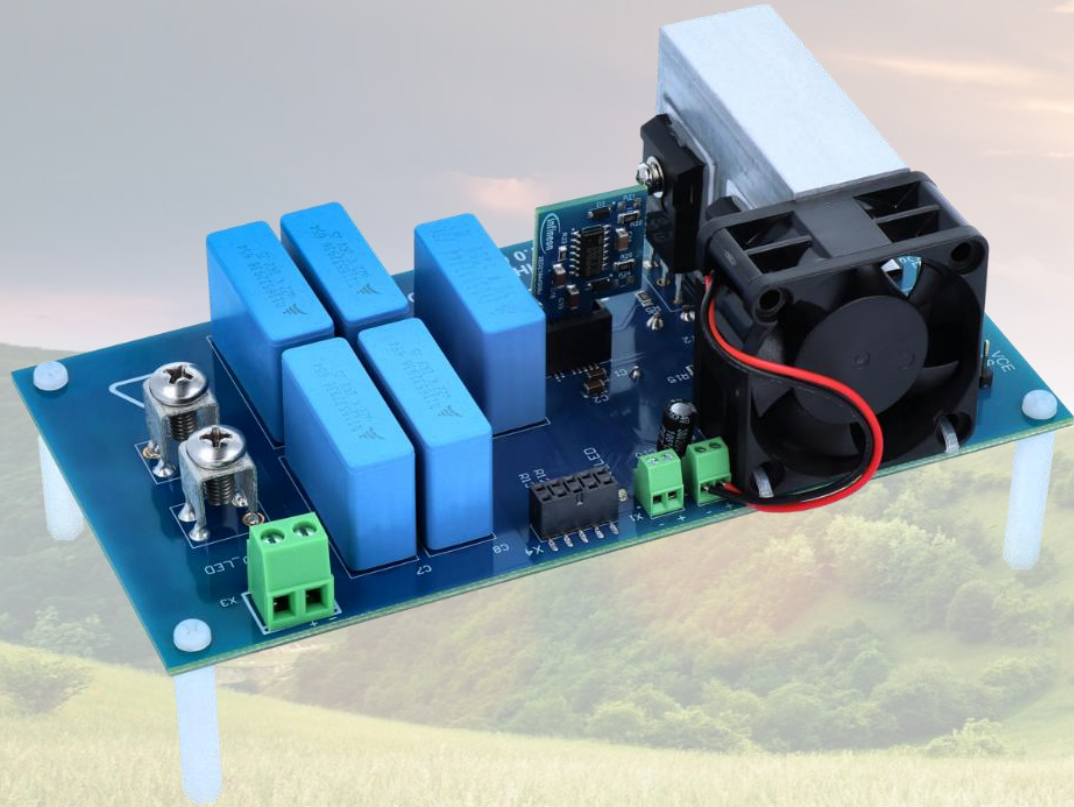


英飞凌家电生态圈
<赋能课堂>

3千瓦半桥感应加热评估板 (采用650V 逆导型R6系列IGBT)

Peter Wang
2022 June





3KW感应加热半桥评估板EVAL-IHW65R62EDS06
板载具有新的650 V 逆导R6 IGBT，专门为高达50
kHz的感应加热和谐振开关应用设计

Peter Wang
IPC GC SMD FAE

Key Take-away

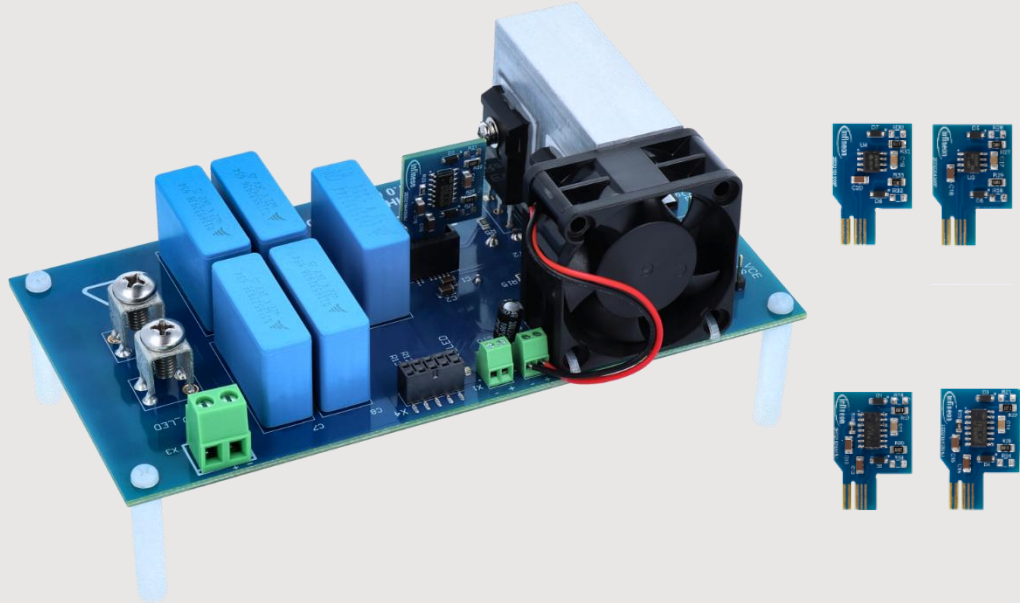
控制板介绍

准谐振半桥原理介绍

英飞凌逆导RC-H6 IGBT和驱动产品介绍

3 kW half bridge induction heating evaluation board with 650 V Reverse Conducting R6 IGBT

EVAL-IHW65R62EDS06J - Top side



Main Features

- Input voltage: 180 – 270 Vdc
- Max auxiliary supply voltage: 20 Vdc
- Nominal output power: 3 kW

Customer Benefits

- Easy to measure waveforms of IGBT
- Easy exchange or replacement of resonant coil
- Easy evaluation of different gate driver ICs
- Direct access to the device for thermal measurements

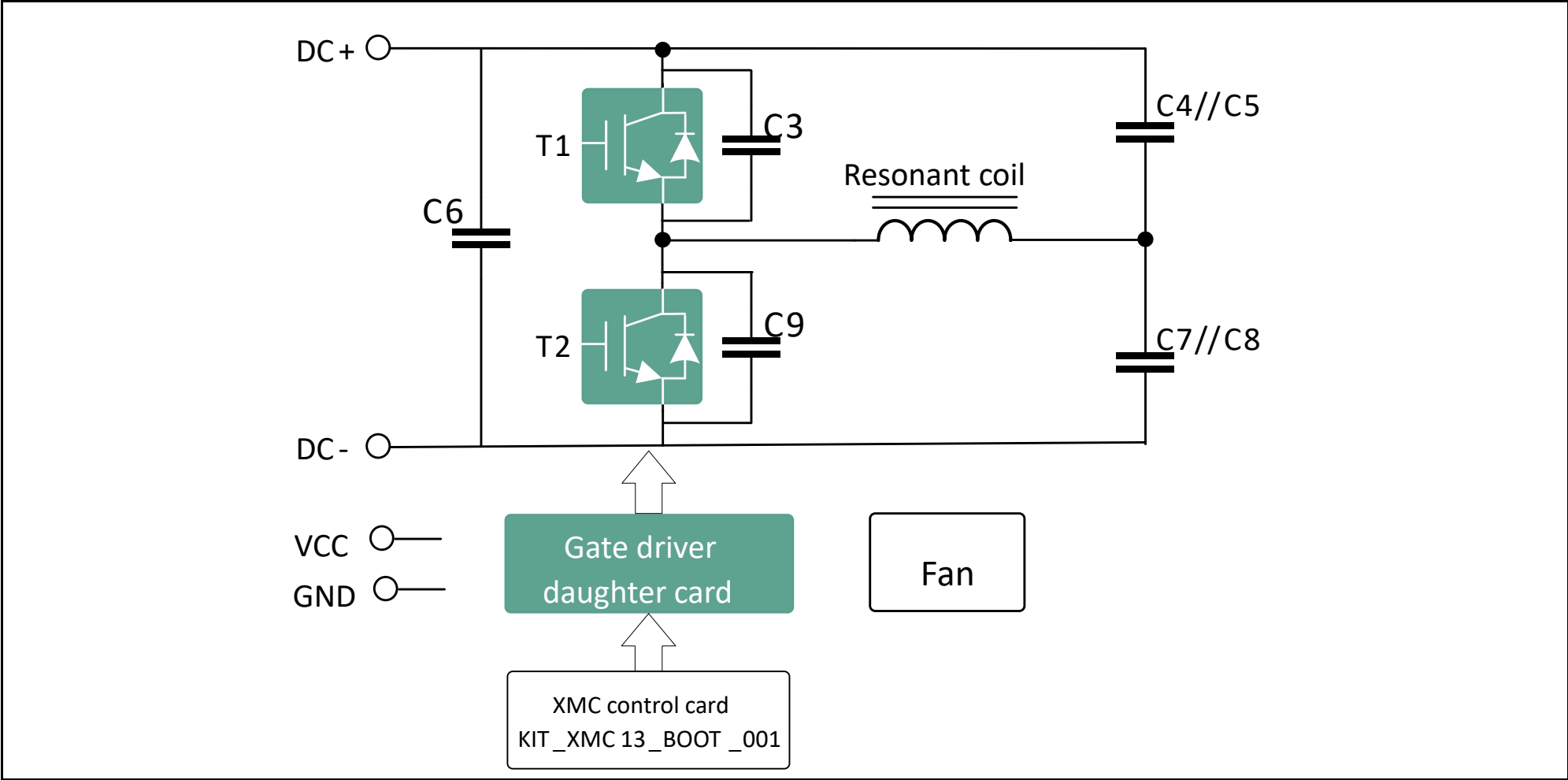
Applications



Ordering information

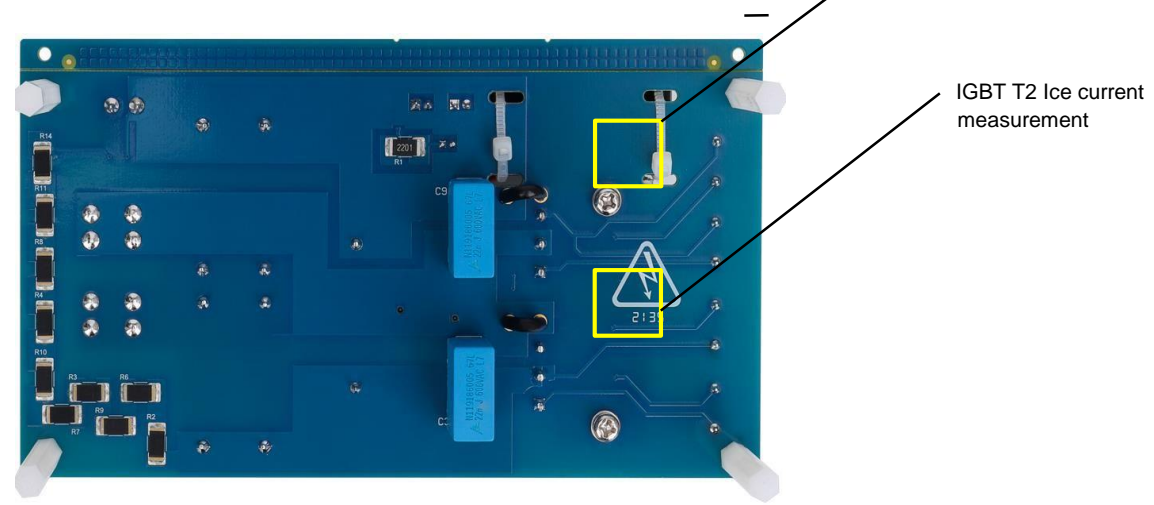
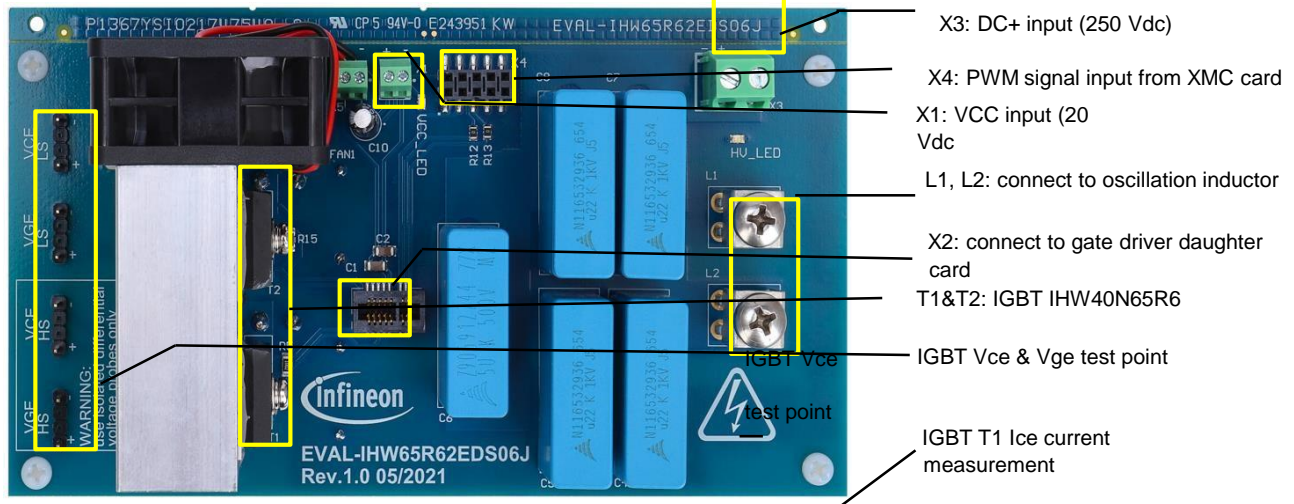
- Sales Code: SA005678249
- SP-number: SP005678248
- OPN: EVALIHW65R62EDS06JTOB01

Block diagram



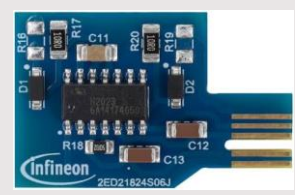
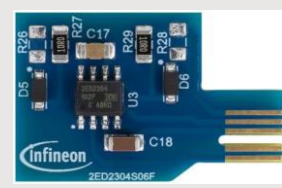
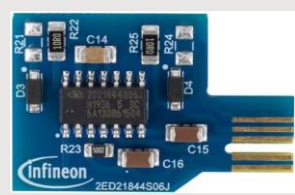
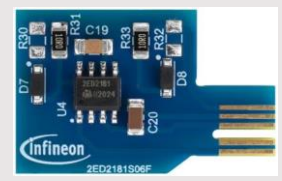
The board at a glance

Picture of board



Main Features

- › Have isolated low-voltage power supplies ready for input support and logic supply ($VCC1$) with a current capability of at least 2.5 A for $VCC1$
- › Have a high-voltage power supply ready for HV-DC between $X3+$ ($V-HV$) and $X3-$ (HV_GND)
- › Have the load coil ($\sim 65 \mu\text{H}$) ready, or any other coil that is suitable for induction cooking application
- › Have the XMC 1300 Boot Kit board ready and programmed (or, as an alternative, a dual-channel pulse-width modulation (PWM) generator for half-bridge PWM input)



Evaluation board with four different gate driver daughter cards for evaluation

Infineon products

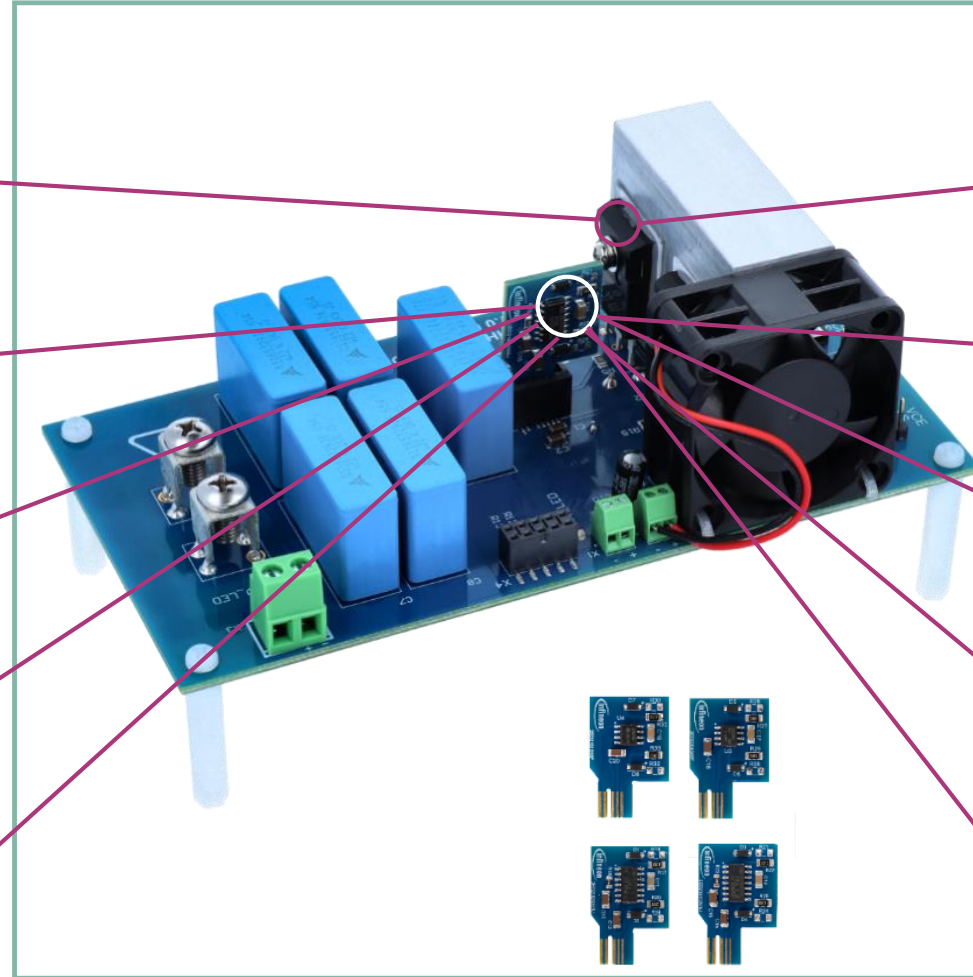
IHW40N65R6

2ED21844S06J

2ED21824S06J

2ED2304S06F

2ED2181S06F



Features

Power stage

Reverse Conducting R6 650 V, 40 A IGBT in TO247 package

Gate driver

650 V, 2.5 A half-bridge gate driver with shutdown in DSO-14 package

Gate driver

650 V, 2.5 A half-bridge gate driver in DSO-14 package

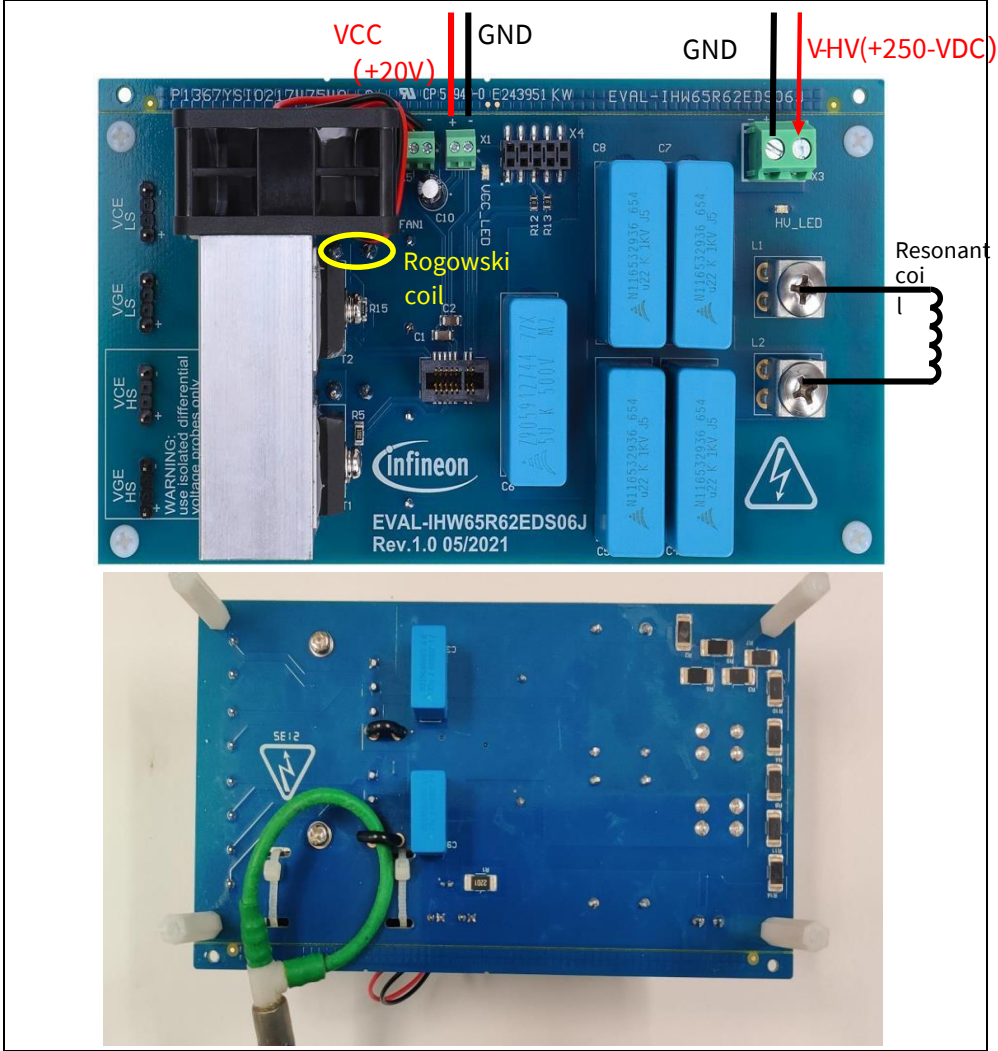
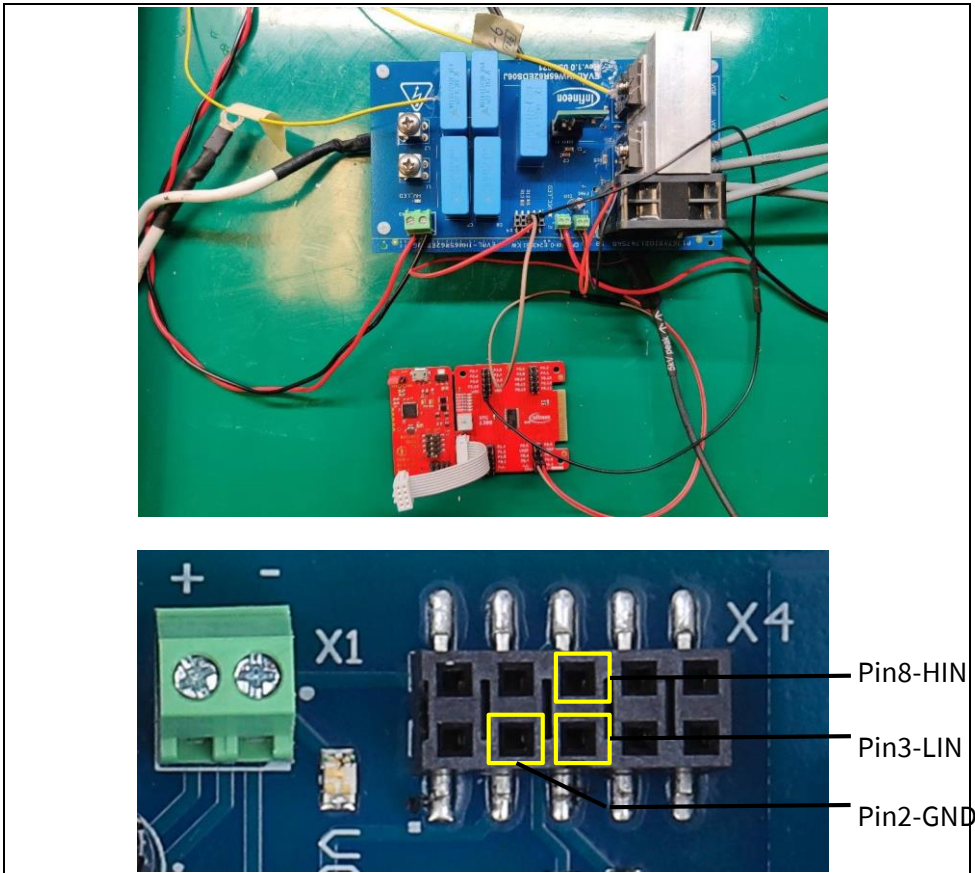
Gate driver

650 V, 0.36 A source and 0.7 A sink currents half-bridge gate driver in DSO-8 package

Gate driver

650 V, 2.5 A half-bridge gate driver in DSO-8 package

Connection of measurement probes



Key Take-away

控制板介绍

准谐振半桥原理介绍

英飞凌逆导RC-H6 IGBT和驱动产品介绍

System Trend

Applications

Topologies

Features

Rice-jar



Table-top

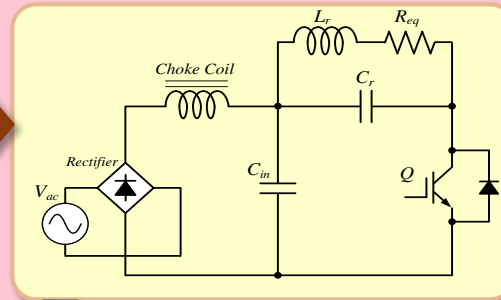


Microwave oven



<2.3kW

SE Inverter



⚡ Only 1000V~1600V IGBT opportunity

- Lower cost structure
- BJT gate drive circuit is common
- ⚡ No needs PFC
- No bulk capacitor
- Choke coil & input cap. form a passive PFC (>95% PF)

⚡ Advantages

- Needs only single IGBT
- No needs isolated gate drive circuits
- Simpler and cheaper
- No need high performance co-pak diode
- RC IGBT is prefer

⚡ Disadvantages

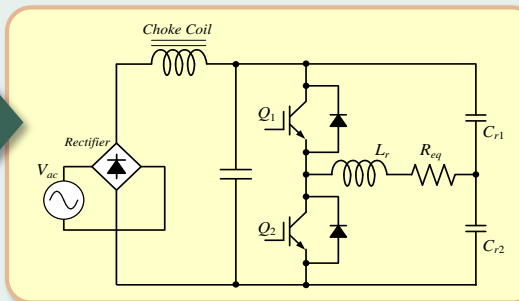
- Needs high voltage components (IGBT, Capacitor & Inductor)
- Output power limitation : < 2.3kW

Cook-top



<2kW

HB Inverter



⚡ Two 600V(or 650V) IGBTs & HVIC (or opto) opportunity

- ⚡ No needs PFC
- No bulk capacitor
- Choke coil & input cap. form a passive PFC (>95% PF)

⚡ Advantages

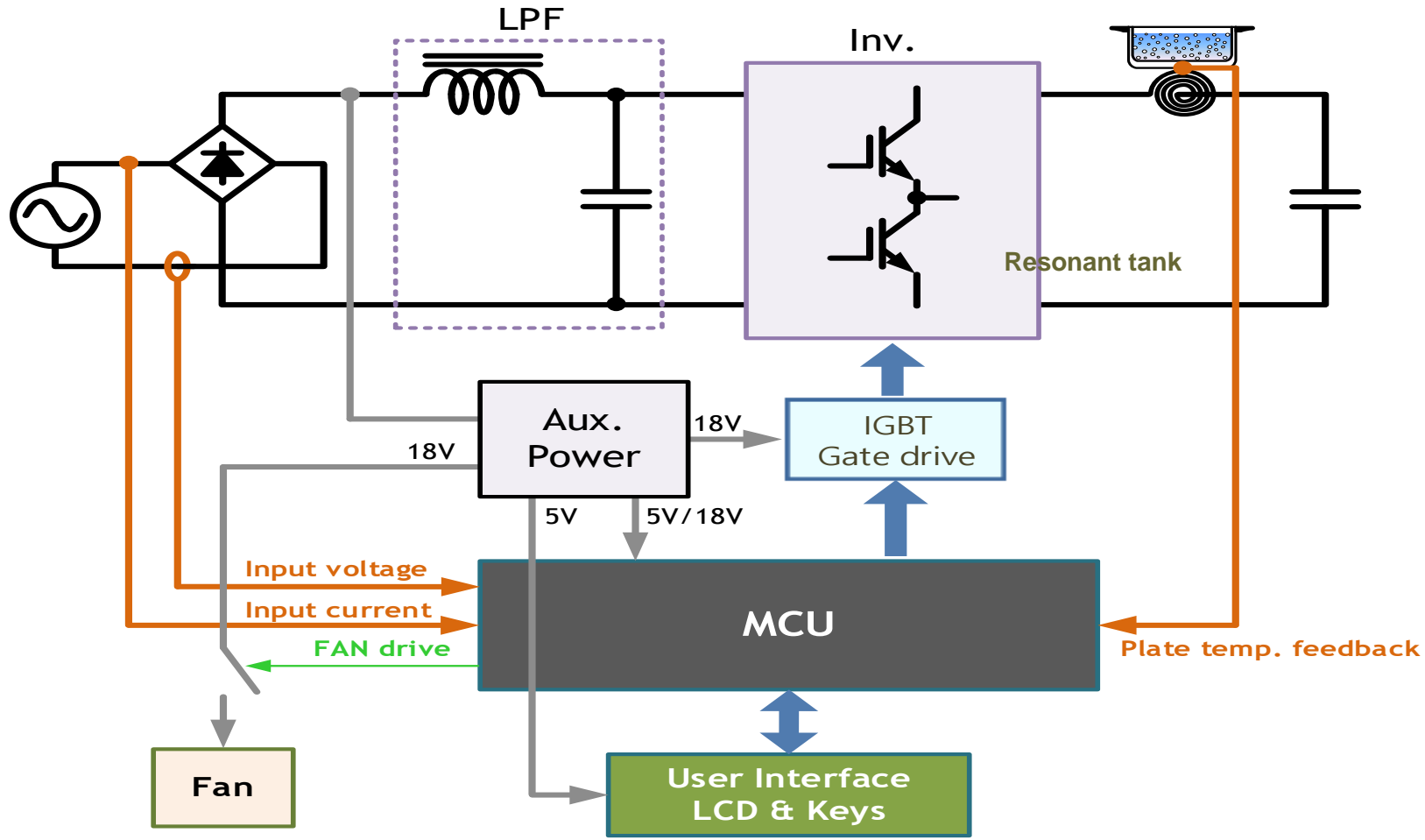
- Prefer to over 2.3kW
- Better efficiency
- Lower working voltage (600V or 650V IGBTs)

⚡ Disadvantages :

- Expensive
 - Needs 2 IGBTs & many resonant capacitors
 - Higher resonant current : thicker wire diameter and device ratings
 - Needs isolated gate drive circuit (HVIC or Opto)
 - Needs high performance co-pak diode



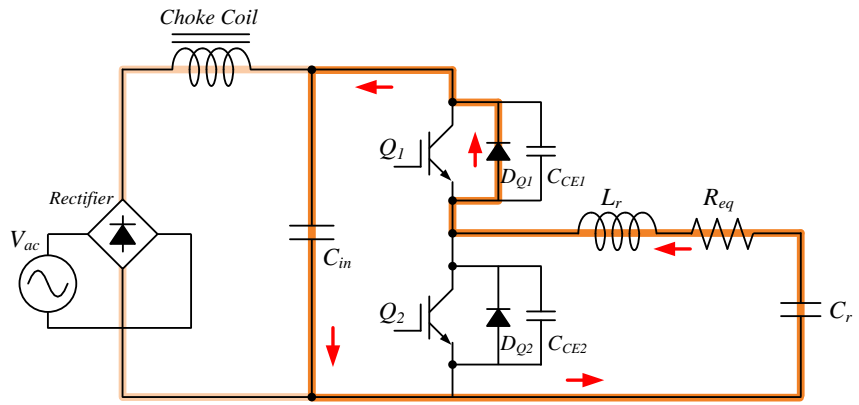
Induction cooking



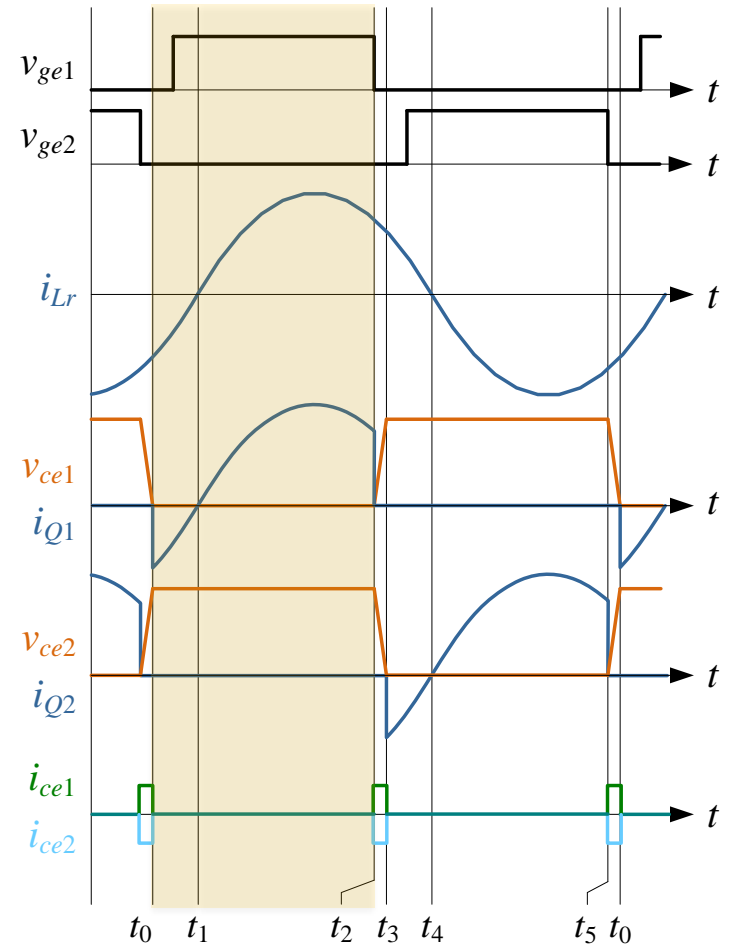
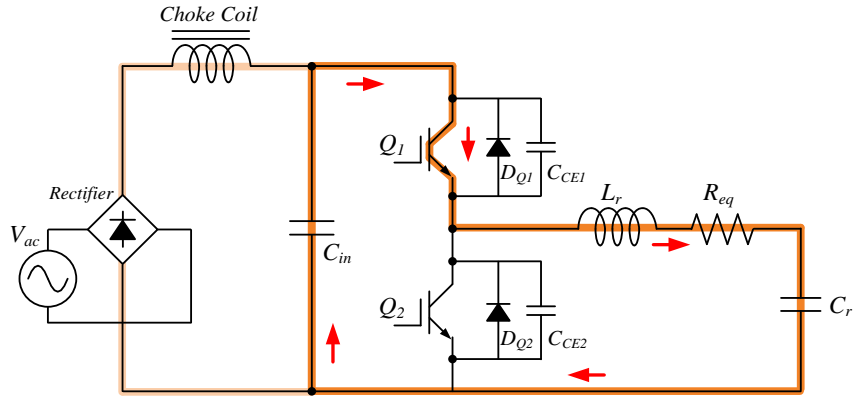
Block diagram of Induction cooking equip.

H/B Resonant Inv. : Operation modes

Mode I (t_0-t_1)

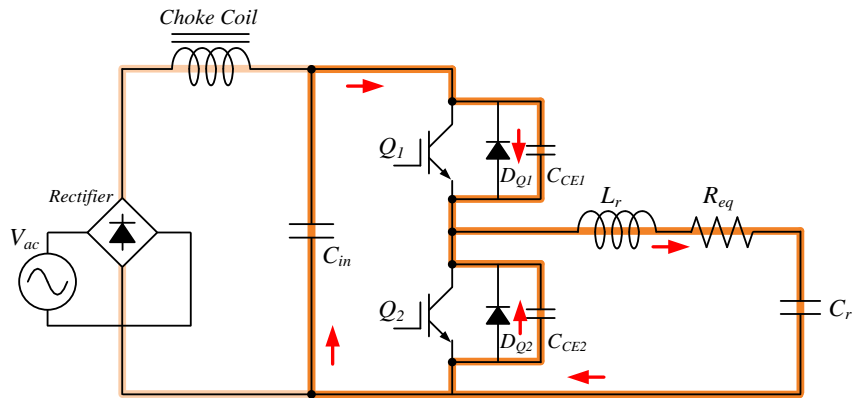


Mode II (t_1-t_2)

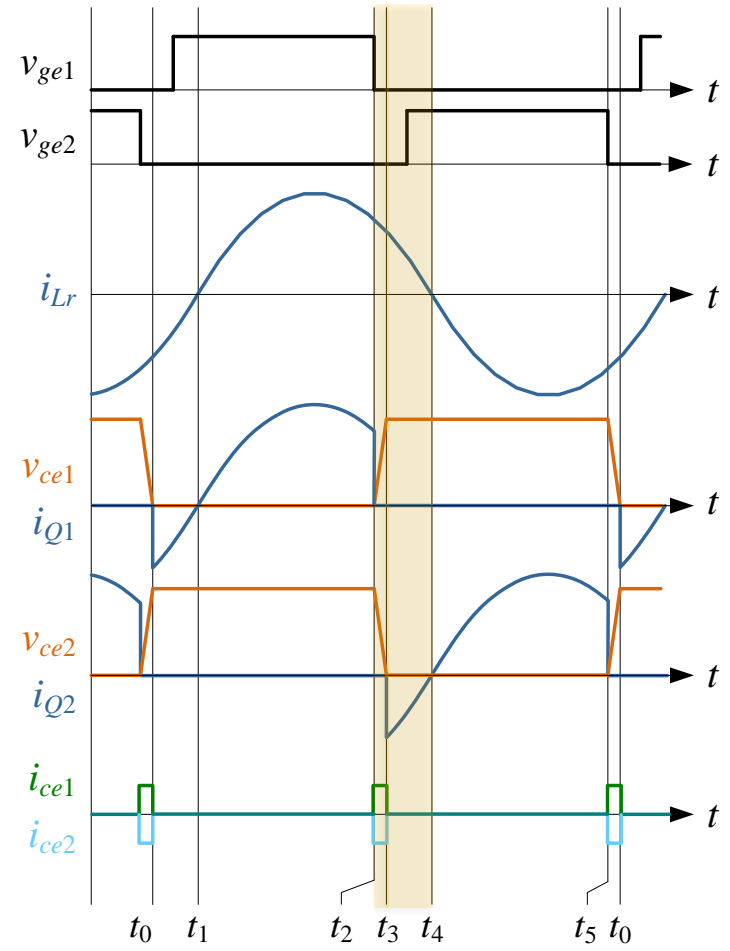
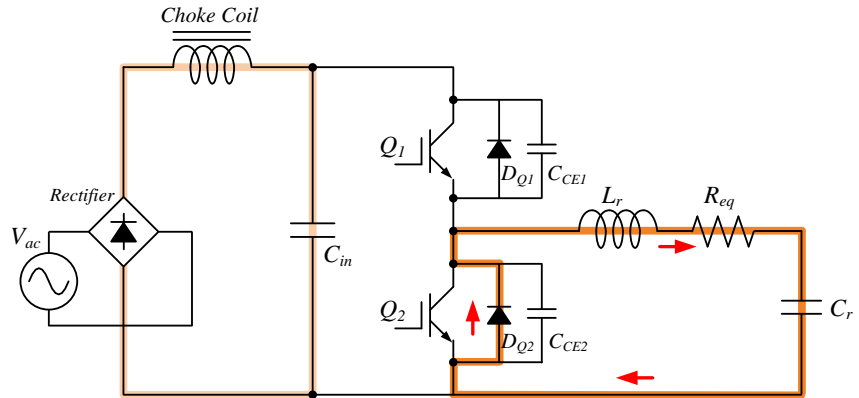


H/B Resonant Inv. : Operation modes

Mode III (t_2-t_3)

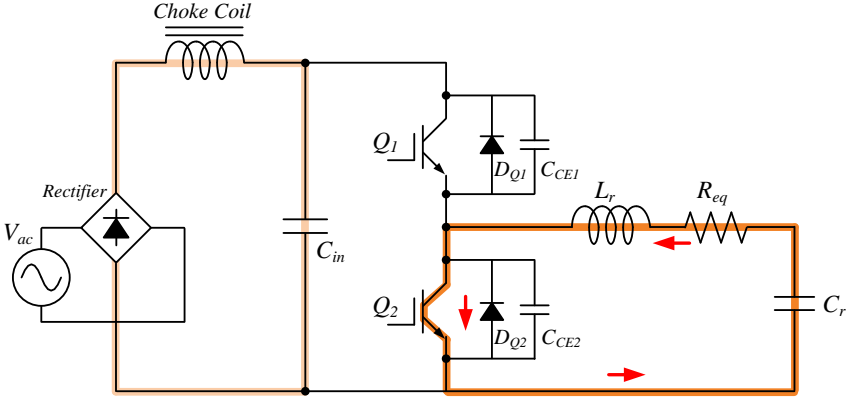


Mode IV (t_3-t_4)

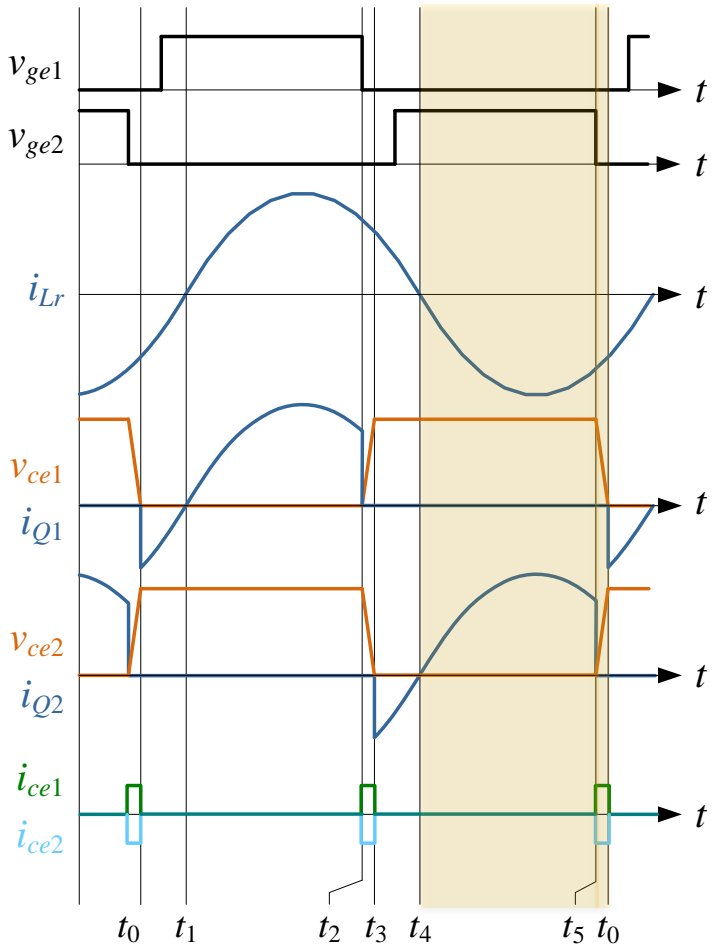
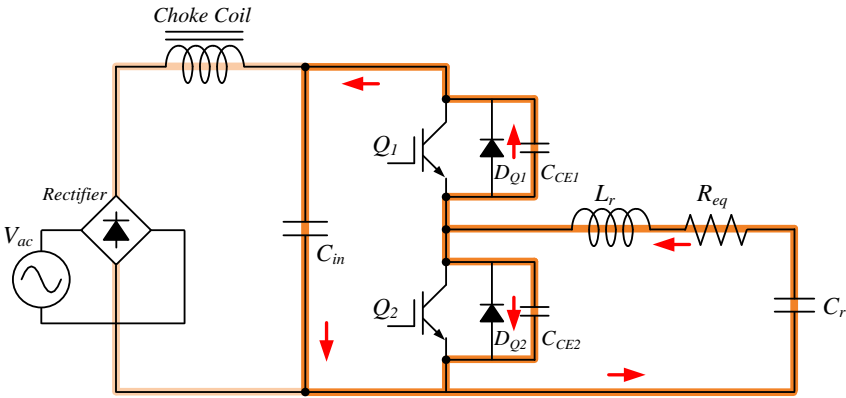


H/B Resonant Inv. : Operation modes

Mode V (t_4-t_5)

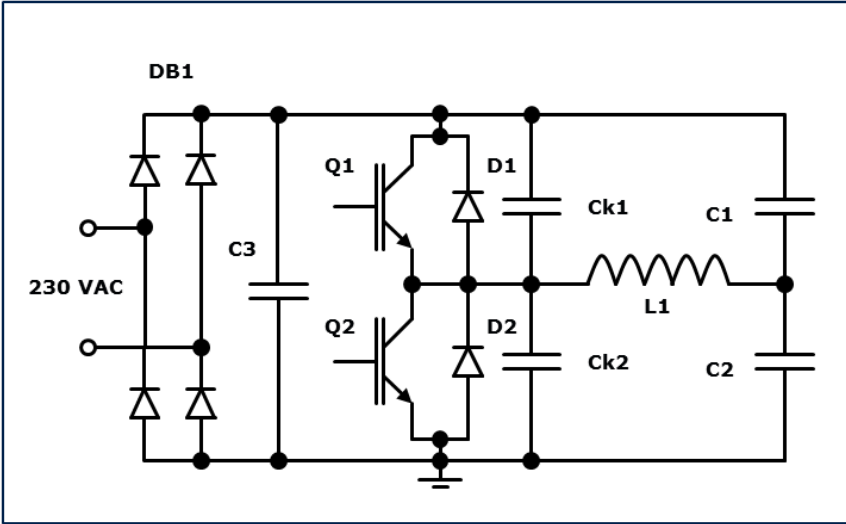


Mode VI (t_5-t_0)

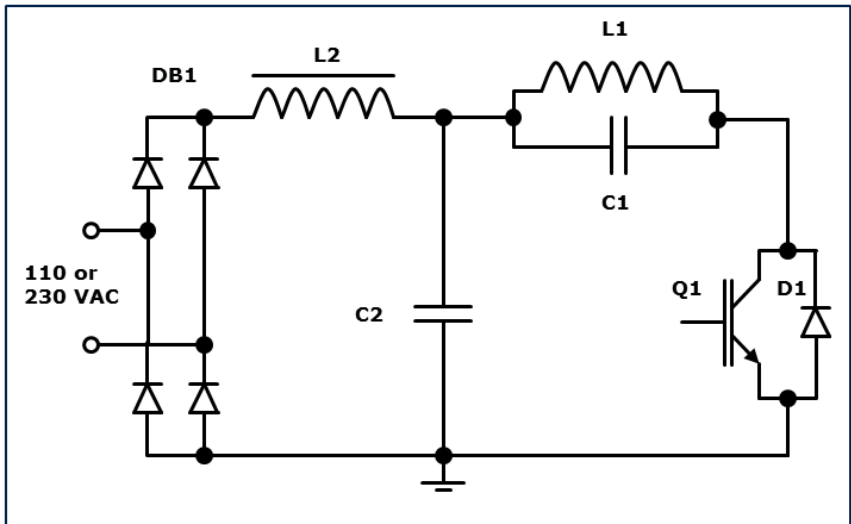


IGBT Topologies in Induction Heating and Microwave Ovens

600V+: Half Bridge Topology



1200V+: Single Ended Topology



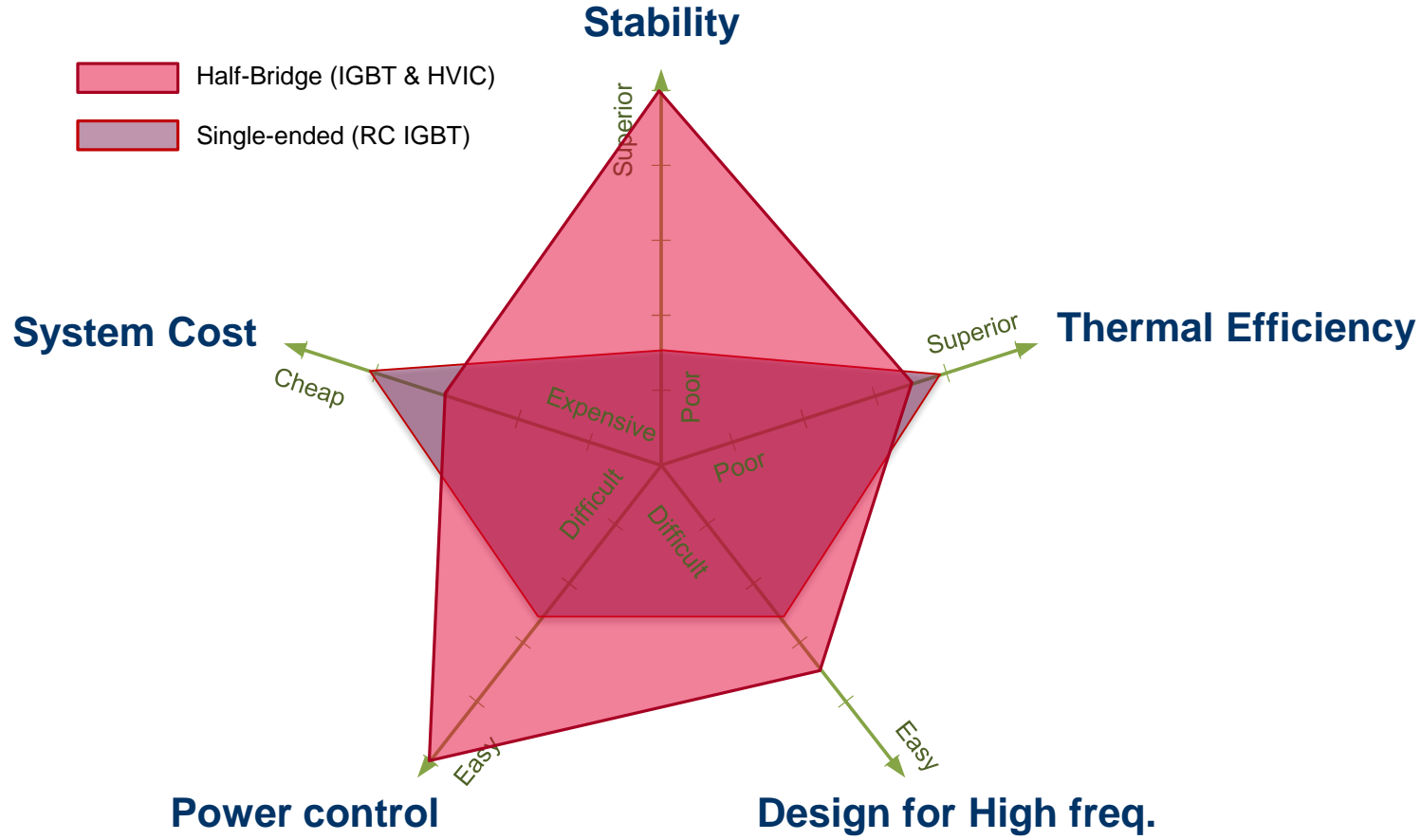
Reverse Conducting IGBTs designed specifically soft switching topologies

RC-H family of devices optimized for the requirements of Induction Cooking systems

- IGBT: low V_{CEsat} , low E_{off} and low R_{th}
- Diode: low V_F

Single-end vs. Half-bridge

Topology comparison



Key Take-away

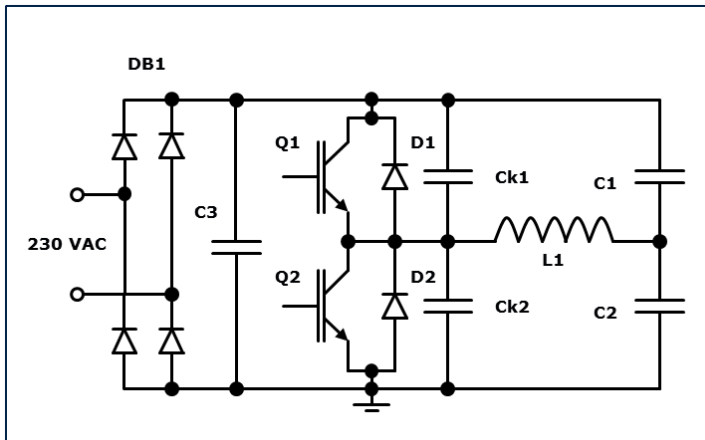
控制板介绍

准谐振半桥原理介绍

英飞凌逆导RC-H6 IGBT和驱动产品介绍

650 V R6 family for induction cooking application in half-bridge topology

650 V: Half-bridge topology



Most common application for half-bridge topology

Multi-Hob induction stoves
Inverterized microwave ovens



Half-bridge topology is preferred for application requiring

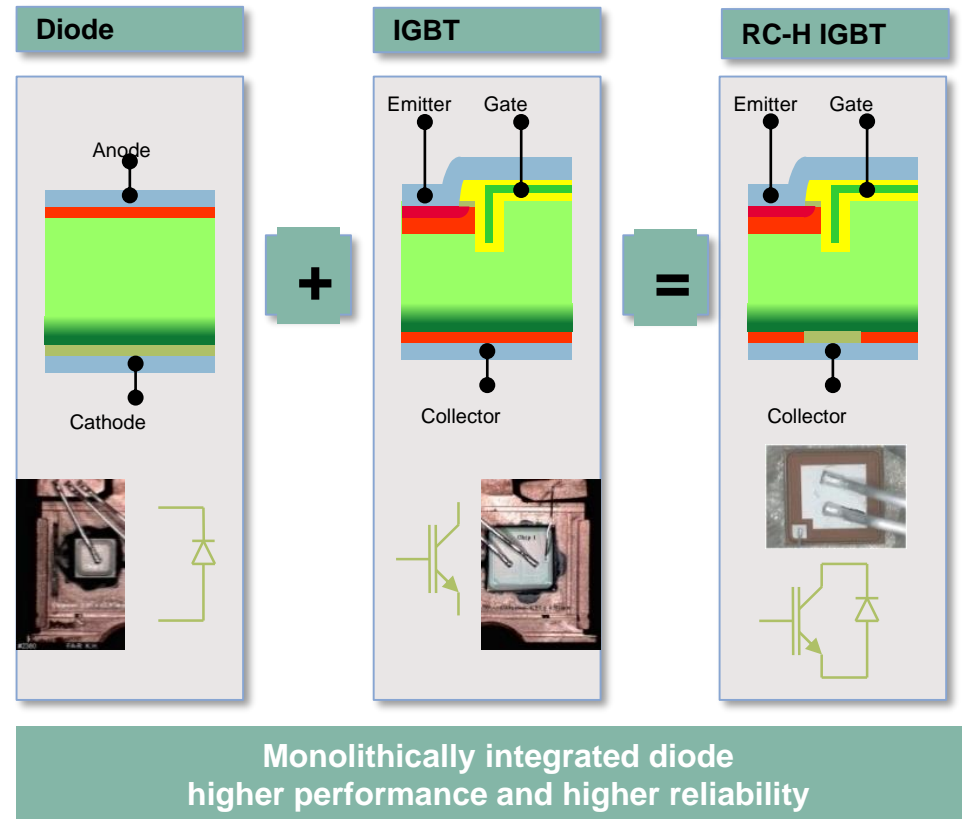
- good power efficiency for wide load range,
- less control requirement due to stable V_{ce} ,
- higher reliability thanks to less sensitivity on control errors (better controllability)

The R6 650 V family, with its monolithically integrated diode, has been designed to fulfil specific requirements of induction heating applications using Half-bridge topology.

Reverse Conducting IGBTs

For induction heating applications

› Technology concept



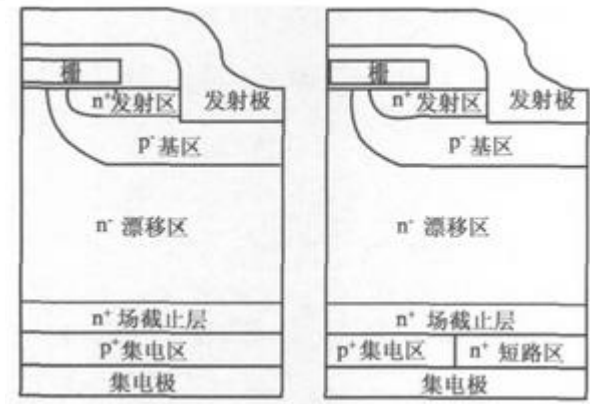
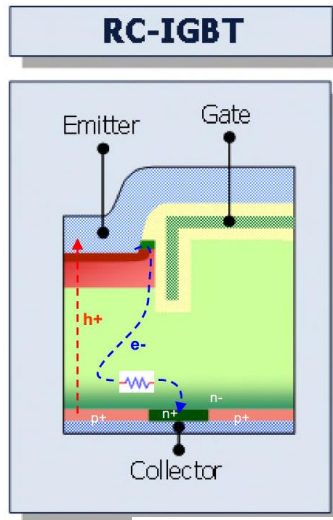
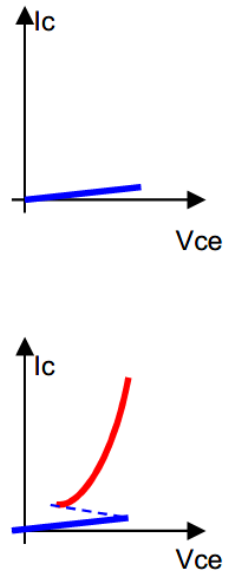
› Free-wheeling diode monolithically integrated with IGBT chip

- **RC-H** families: Performance leadership in resonant topologies
- **RC-E** family: Optimized for best price-performance in soft switching applications like induction cookers

About the RC Technology

The RC IGBT technology from Infineon presents the anti-parallel diode monolithically integrated within the IGBT chip: this is realized by integrating n-type regions in the backside p-emitter of the IGBT

- Snap-back of output characteristics is typical of this technology and due to the turn-on of the backside PN diode of the IGBT structure.
- At low current density, as soon as the MOS channel is turned-on, electron current flows (“Resistive“ characteristics): due to the lateral electron flow in front of the p+ regions, a voltage drop is created, increasing the (positive) potential of the n- drift region.
- By further increasing V_{ce} , when the build-in Voltage of the PN junction is reached, the PN junction suddenly turns-on (“Diode“ characteristics)



传统IGBT与逆导型IGBT结构示意图

Product family at a glance

650 V Reverse Conducting R6 IGBTs

Target key features

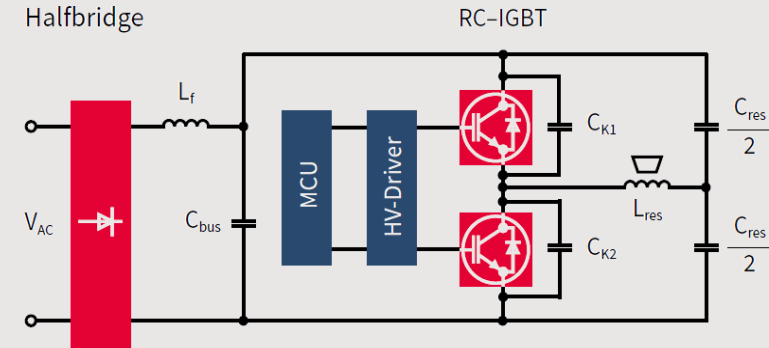
- › Improved IGBT performance to offer best trade-off between power losses and EMI performance
- › Improved diode performance reducing V_f and dependency of gate voltage
- › Diode forward recovery peak and time comparable to co-packed device
- › Portfolio of 30 A, 40 A, and 50 A devices
- › $T_j(\text{max}) = 175^\circ\text{C}$
- › TO247 3pin package



Typical applications



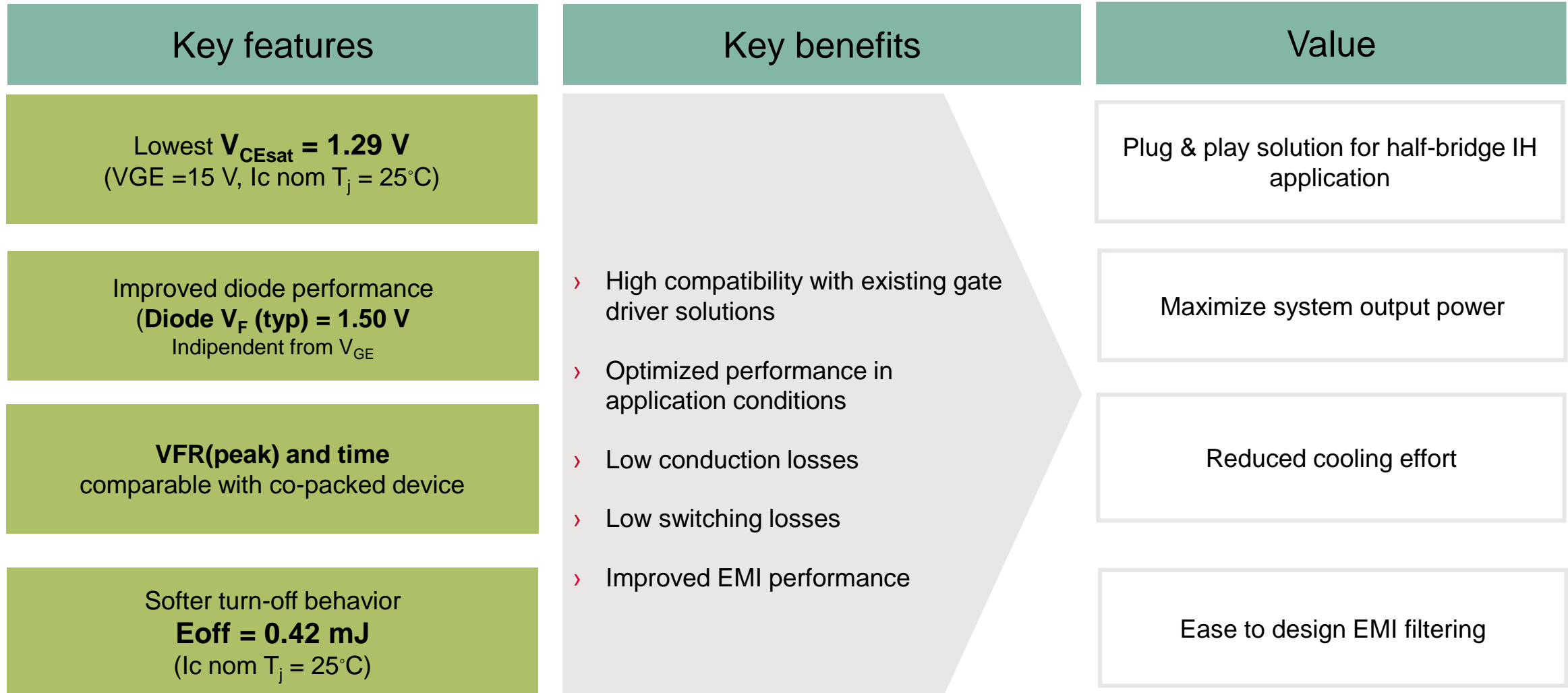
Sample schematic



Value proposition

- › The new specifically designed for induction heating application, in order to meet the specific requirements in term of efficiency (lowest possible losses in soft switching conditions), higher output power (optimal thermal behavior), reliability (standard Infineon quality level) and capacity (12" production line)

Key features and benefits



New RC IGBT portfolio for induction cooking appliances

I _c nom [A]	Features	Price	Performance				Protection
	Topology	Single ended	Half-bridge	Single ended			Single ended
	Family	E1	R6	R5	R5	R5	IPD
	Voltage	1200V	650V	1200V	1350V	1600V	1350V
15		IHW15N120E1					
20				IHW20N120R5	IHW20N135R5		IEWS20R5135IPB
25		IHW25N120E1					
30			IHW30N65R6	IHW30N120R5	IHW30N135R5	IHW30N160R5	
40			IHW40N65R6	IHW40N120R5	IHW40N135R5		
50			IHW50N65R6				
Package		TO247-3	TO247-3	TO247-3	TO247-3	TO247-3	TO247-6
Recommended driver IC		IRS44273L	2ED21844S06J	IRS44273L	IRS44273L	IRS44273L	Co-packed driver with protection functions

What if a customer asks ... Why 650 V Reverse Conducting R6 IGBT?

The infographic features a central white circle with a dark grey border containing the text "650 V Reverse conducting R6". Two lines extend from this circle to the top and bottom of the first column. To the right are four vertical columns, each with a colored header (grey, purple, teal, green) containing an icon and a text block. The icons are: puzzle pieces, a thumbs up, a factory, and a group of people.

650 V Reverse conducting R6

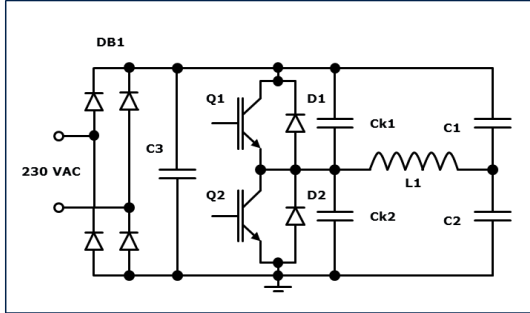
- No. 1 supplier of IGBTs ***
- Product portfolio coverage from 650 V to 1600 V**
- World-class production, quality, and business continuity support**
- Experienced, best in class application engineers, and excellent support**

www.infineon.com/rch6

* Based on or includes research from Omdia, "Power Semiconductor Market Share Database – 2020", September 2020

650 V Reverse Conducting R6 IGBTs in a nutshell

650 V: Half-bridge topology



650 V R6 portfolio

Current class	650 V
30 A	IHW30N65R6
40 A	IHW40N65R6
50 A	IHW50N65R6
Package	TO247 3pin
Suggested driver	2ED21844S06J

650 V R6 IGBT

- Improved IGBT performance to offer best trade-off between power losses and EMI performance
- Improved diode performance reducing Vf and dependency of gate voltage
- Diode forward recovery peak and time comparable to co-packed device
- Very tight parameter distribution in production to guarantee **Infineon standard quality**
- Infineon is No. 1 in power semiconductor, with world-class Front-End and Back-End capacity

650 V Reverse Conducting R6 IGBT represents the optimal choice for half-bridge resonant topology

650 V Reverse Conducting R6 IGBTs

Support materials



Collaterals and brochures

- Product briefs
- Selection guides
- Application brochures
- Presentations
- Press releases, ads

Technical material

- Application notes
- Technical articles
- Simulation models
- Datasheets, MCDS files
- PCB design data

Evaluation boards

- Evaluation boards
- Demo boards
- Reference designs

Videos / Distribution trainings

- Technical videos
- Product information videos

Family page

[650 V/ 1200 V/ 1350 V/ 1600 V Next Generation Reverse Conducting IGBT](#)

Product type pages

[IHW30N65R6](#)

[IHW40N65R6](#)

[IHW50N65R6](#)

Additional product presentation

[Discrete IGBT & SiC - Overview for Distributors](#)

Training

[Online course TRENCHSTOP™ IGBT6 and RC-D2 for consumer drives below 300 W](#)

2ED21844S06J

The perfect match for your system

2ED218xS06F / 2ED218x4S06J

650 V half-bridge and HS+LS high current gate drivers

Key features

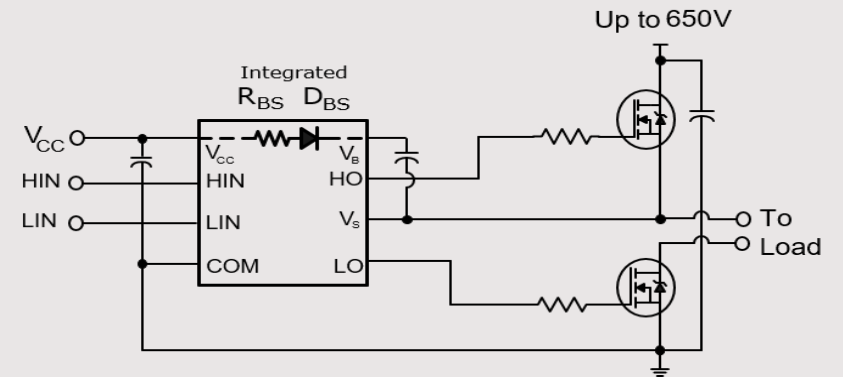
- › Infineon SOI technology fully operational up to **650 V offset voltage**
 - **Bootstrap voltage** up to **675 V**
- › **Negative VS transient immunity of 100 V**
- › **Integrated** ultra-fast, low $R_{\text{DS(on)}}$ **bootstrap diode**
- › $I_{\text{O+}} / I_{\text{O-}}$ drive currents of **2.5 A / 2.5 A** (typical)
- › Independent, dual channel under voltage lockouts (UVLO)
- › Supports **maximum supply voltage of 25 V**
- › **Logic operational for V_{S} of -11 V**
- › Reduced level shift losses for switching **frequencies above 100 kHz**
- › Dual package options
 - 2ED218xS06F: DSO-8 (SOIC-8)
 - 2ED218xS06J: DSO-14 (SOIC-14) with separate power and logic ground

Key applications



Part number	$I_{\text{O+}}$, typ. [A]	$t_{\text{ON/OFF}}$ (typ) [ns]	MT (max) [ns]	$t_{\text{r/f}}$ (typ) [ns]	Pin compatibility
2ED218xS06F	2.5 / 2.5	200 / 200	60	15 / 15	IR218xS / IRS218xS
2ED218x4S06J	2.5 / 2.5			15 / 15	IR218x4S / IRS218x4S

Sample schematic



Value proposition

- › Highest reliability and quickest time to market with superior negative VS immunity
- › Lower BOM system level cost with integrated, monolithic bootstrap diode
- › Superior latch-up immunity with SOI
- › Simple, low-cost solution to drive MOSFETs or IGBTs up to 650 V
- › Reduced level shift losses, tailored for high frequency applications
- › Robust IC with increased device reliability
- › Form, fit, function, pin2pin, and electrically compatible with earlier generation drivers





Part of your life. Part of tomorrow.