Teardowns, deep analysis of competing products and technologies for new product development, patents' enforcement, and defense

What you see inside these SiC power devices are worth revealing…

By Louis Burgyan, LTEC Corporation

October 2017. …but first, let's look at the big picture as we move towards reducing CO_2 emission. In the USA, household air conditioning systems release 117 million metric tons of CO_2, annually, not including industrial and commercial heating, ventilation, and air conditioning systems [1]. Now consider the potential impact of a *single* wide bandgap semiconductor product: according to the manufacturer, *Mitsubishi's 600V/15A PSF15S92F6 Super-mini Full Sick Intelligent Power Module™* can reduce its power loss by 70% relative to comparable conventional Si-based modules. If I assume 95% efficiency in a conventional Si-based power module, and calculate the power saving by the new SiC power module while further assuming that all home air conditioners in the US would use SiC power module having power efficiency like the Mitsubishi device, the net yearly power saving would lead to 409,500 metric tons of CO_2 *not released into the air*. *This is a big number!* Think about the total realizable impact of wide bandgap semiconductors on CO_2 emission. I remain hopeful.

Aside from being the first SiC module developed for consumer applications, what's most impressive to me in Mitsubishi's module is that it was designed for delivering high efficiency in a small footprint at optimized cost. While the cost of SiC die is surely higher than similar Si solutions, the lower heat generation, smaller heat sink, and higher level of integration will undoubtedly lead to overall cost savings at system-level relative to comparable 600V super junction MOS and IGBT modules. To make life easier, you will find a low-voltage driver IC with no need for negative gate bias, a high-voltage driver IC, three bootstrap diodes, and six SiC power MOFETs, all crammed into a conventional, *low-cost* lead frame-based package using wire bonding. Clearly, this product is a great example to show that low-cost, high performance, high volume deployment of SiC technology is practical today in price-sensitive consumer products.

Moving onto other things, LTEC announced a new structure and device analysis report, the first to reveal new technology deployed in *Infineon's FF11MR12W1M1_B11 CoolSiC™ half-bridge power module.* This module features Infineon's first normally OFF SiC device having a *novel asymmetrical trench MOSFET structure* developed to reduce electric field stress on the

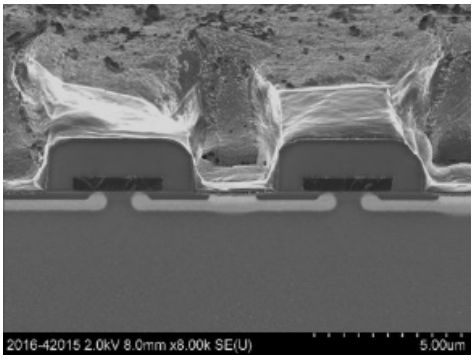
gate oxide. Its optimized body diode with deep P+ emitter allows elimination of externally connected free-wheeling diode. Our report also presents a comprehensive evaluation and analysis of the contributing elements determining ON-resistance of the device.

Infinieon's IJW120R100T1 1200V SiC JFET power semiconductor has its own appeal: This device, while using mature technology, a polite name for "old," we feel, is worth analyzing because it delivers *robust SiC performance* without the potential reliability concerns sometimes associated with SiC power MOSFETs. This user-friendly device, having *lateral channel buried below the surface*, doesn't have critical gate oxide, thus avoiding potential issues with Drain Induced Barrier Lowering (DIBL.) Implemented in a cascode configuration with a low-voltage MOSFET at the bottom, this device is really *easy to use*. Read on below, and follow the links to review the table of contents of our detailed analysis reports.

New technical analysis reports:

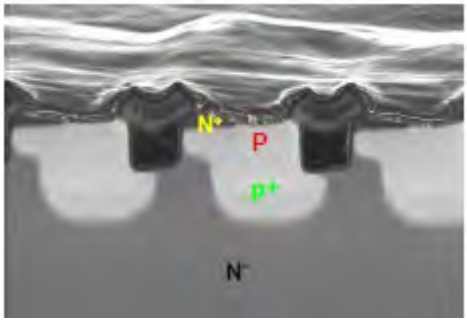
Click on the titles below

Mitsubishi 600V/15A PSF15S92F6 Super-mini Full SiC Intelligent Power Module



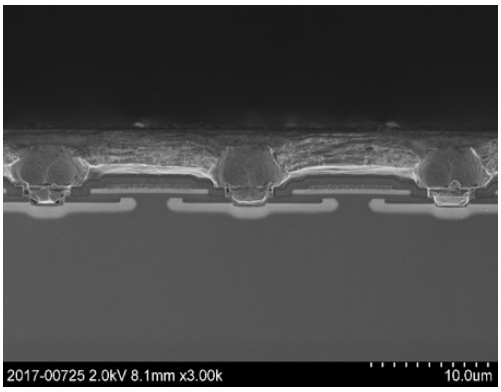
The report has two independently purchasable parts: a detailed structure analysis and a process analysis. The structure analysis report contains all needed X-ray, optical, and SEM images plus EDX spectral images needed to gain a thorough understanding of this SiC MOSFET design. The process analysis section reveals die-edge details, device structure with dimensions, device layout, channel structure and impurity analysis, and a reconstructed manufacturing process flow [17G-0009-1].

Infineon FF11MR12W1M1_B11 CoolSiC™ half bridge module analysis report



LTEC Corporation released a detailed structure and process analysis report of this 1200V silicon carbide MOSFET power module, the 1st product using a unique asymmetric trench gate transistor design. This device has low Ron relative to comparable products from other device makers such as Rohm and Wolfspeed. The report has two individually purchasable Structure Analysis and Device Analysis sections [17-0019-1].

Infineon 12R100T1SiC JFET transistor analysis report



This 1200V normally ON SiC JFET semiconductor power device is arranged in a user-friendly cascode configuration. The structure analysis report contains all needed X-ray, optical, and SEM images plus EDX spectral images needed to gain a thorough understanding of this SiC JFET design. The process analysis section reveals die-edge details, a reconstructed device structure with dimensions, device layout, channel structure and impurity analysis, and even a reconstructed manufacturing process flow[17G-0002-1].

Bi-directional DC-DC converter for the Honda Shuttle hybrid vehicle

This This is a detailed circuits analysis report of the bidirectional buck-boost 12V DC-DC converter system found in the Honda Fit hybrid vehicle. PCB structural details with various dimensions, component list, block diagram and detailed circuit schematics are included[16G-0005-1].

Click on the link to see many additional report brochures:

www.ltecusa.com

References

[1] https://energy.gov/energysaver/air-conditioning

LTEC Corporation also provides a broad range of services in the field of Intellectual Property (IP) services from patent prior art search to in-depth technical analysis for the automotive industry. Visit our website www.ltecusa.com and let us know how we can help you keep up with the competition or help generate and protect your intellectual property.

About LTEC Corporation

LTEC, Japan's dominant intellectual property analysis company, provides in-depth competitive technical analysis, benchmarking, and reverse engineering services for the research and development engineering and industrial legal communities in the form of an

innovative and collaborative approach. The primary focus of the company is on vehicle electrification, autonomous vehicles, ADAS, all types of semiconductors including SiC and GaN devices, and automotive, and power electronics. With regional offices in the USA, Japan, Korea, and Taiwan, LTEC helps its customers overcome intellectual property (patent) research, analysis, and protection challenges across all sectors of electronics. With over 100 highly trained engineers and Ph. Ds, and 33-years of an impeccable track record, LTEC stands ready to help retain or gain a competitive edge for its clients worldwide. www.ltecusa.com

 Share  Tweet  Forward  Share

You are receiving this email because we think you are interested in vehicle electrification projects

LTEC Corporation
Corporate Head Office
4-42-8 Higashi-Arioka, Itami
#500
Hyogo, 664-0845 JAPAN

US Representative Office
2880 Zanker Road, Suite 203
San Jose CA 95134

(408) 432-7247

info@ltecusa,com

US Sales Office
Fides Sales
2310 Homestead Road, C1

Los Altos, CA 94024
1 (408) 673-0073
sales@fidessales.com
www.FidesSales.com