UnitedSiC Is Now Qorvo | TECHNICAL PRODUCT OVERVIEW

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750V Gen 4 SiC FETs extend performance leadership while enabling new levels of design flexibility

UnitedSiC (now Qorvo) has expanded its breakthrough Gen 4 SiC FET portfolio, extending performance leadership with a 750V/6mOhm SiC FET offered in a TO-247 4-lead package and down to an on-resistance of 9mOhm in a D2PAK-7L surface mount package. The new SiC FETs offers the industry's lowest rated $R_{DS(on)}$ in standard discrete packages and are the only ones in their class to offer robust short circuit withstand time rating of 5µs (see Figure 1).

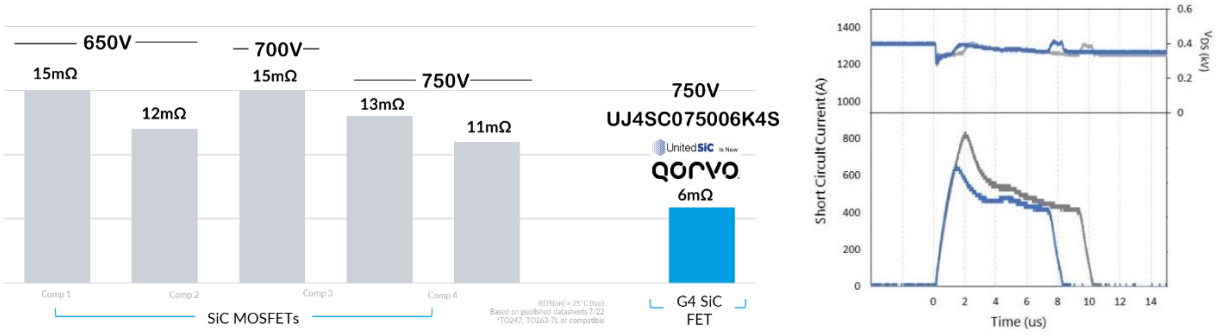

Figure 1. 750V Gen 4 UnitedSiC FET low on-resistance UJ4SC075006K4S compared to SiC MOSFET competitors in similar 650V-750V class and low short circuit current time of 5µs for 6mohm device

Leveraging the industry's best on-resistance x Area ($R_{DS(on)}$ x A), UnitedSiC has broadened its Gen 4 FET portfolio across a range of power levels and package options, offering best-in-class Figures-of-Merit. The 750V SiC FETs are available with on-resistance from 6mOhm to 60mOhm in TO-247-3L and TO-247-4L through-hole packages and from 9mOhm to 60mOhm in low inductance, surface mount D2PAK-7L packages that offer a high-voltage capable 6.7mm creepage distance. The SiC FETs employ advanced wafer thinning and silver-sinter die attach technology, delivering superior thermal performance. Figure 2 illustrates the expanded 750V portfolio, with 8 on-resistances in both through-hole and surface mount devices, providing designers more flexibility to optimize their system for efficiency, thermal management complexity, and cost without having to compromise with a limited selection. The full selection of 750V devices also allows designers to address many applications and power levels with the same benchmark technology supplied by UnitedSiC, rather than designing in multiple different manufacturers' SiC components to cover their range of products. The low on-resistance options are offered in kelvin-source connected packages (TO-247-4L and TO-263-7L), allowing users faster high-current switching with cleaner gate waveforms.

Meanwhile, the lower power SiC FETs (18mOhm-60mOhm) are offered in kelvin connected and traditional TO-247-3L options.

Figure 2. 750V Gen 4 UnitedSiC FET Offerings by $R_{DS(on)}$ and discrete package type

An example of the design flexibility is illustrated in Figure 3 where several parts are compared in a 3.6kW Totem Pole Power Factor Correction (TPPFC) circuit. The TO-247-4L FETs offered from 18mOhm to 60mOhm are excellent choices for TPPFC applications. The figure shows the performance obtained with the new 23mOhm, 33mOhm and 44mOhm 750V SiC FETs, reaching peak efficiencies over 99.3%. If optimizing full load efficiency or minimizing the thermal management requirements is of high importance, one may select the UJ4C075018K4S. If light to mid-load efficiency and cost-performance ranks high on customer demands, the UJ4C075023K4S or UJ4C075033K4S are excellent selections. Meanwhile, tailoring the selection for lower power (e.g. 1.5kW) systems and lower-cost options can lead designers to the UJ4C075044K4S and

UJ4C075060K4S products. Each of these options can be evaluated in a wide range of topologies simply in the UnitedSiC FET-JET Calculator (https://info.unitedsic.com/fet-jet), illustrating the ability to design without compromise with the expanded portfolio of products.

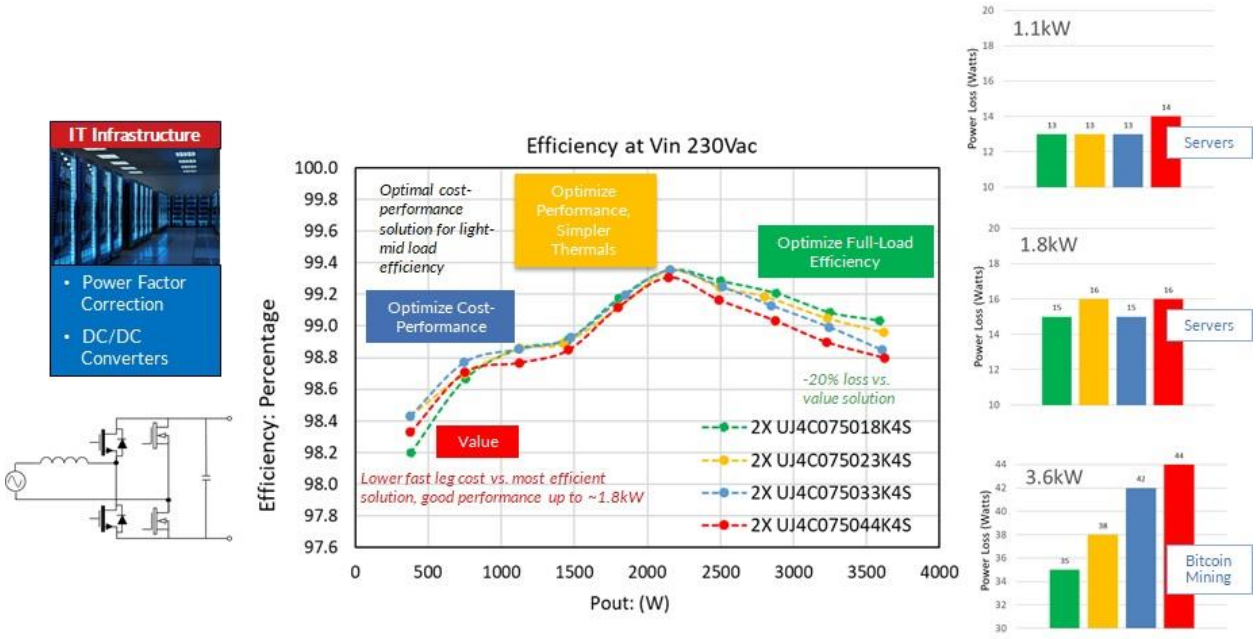

Figure 3. 750V Gen 4 UnitedSiC FET performance in a 3.6KW Totem Pole PFC. The colored bars indicate the power loss using different devices, all of which can be used, but offer different efficiency at full load.

UnitedSiC's Gen 4 SiC FETs offer breakthrough performance levels designed to accelerate WBG adoption in automotive and industrial charging, traction inverters, solid-state circuit breakers, telecom rectifiers, datacenter PFC and DC/DC conversion as well as renewable energy and energy storage applications.

With a 750V rating, additional design margin for 400V or 500V battery/bus voltage applications is provided. Despite the increased voltage rating, these devices employ advanced cell density to reduce the $R_{DS(on)}$ per unit area, delivering the industry's lowest resistance products in all packages. In addition, high current ratings are achieved by the devices' advanced sintered die attach technology offering improved thermal performance. The SiC FETs offer the industry's best specific on-resistance (Figure 4), substantially lowering conduction losses across the full temperature range.

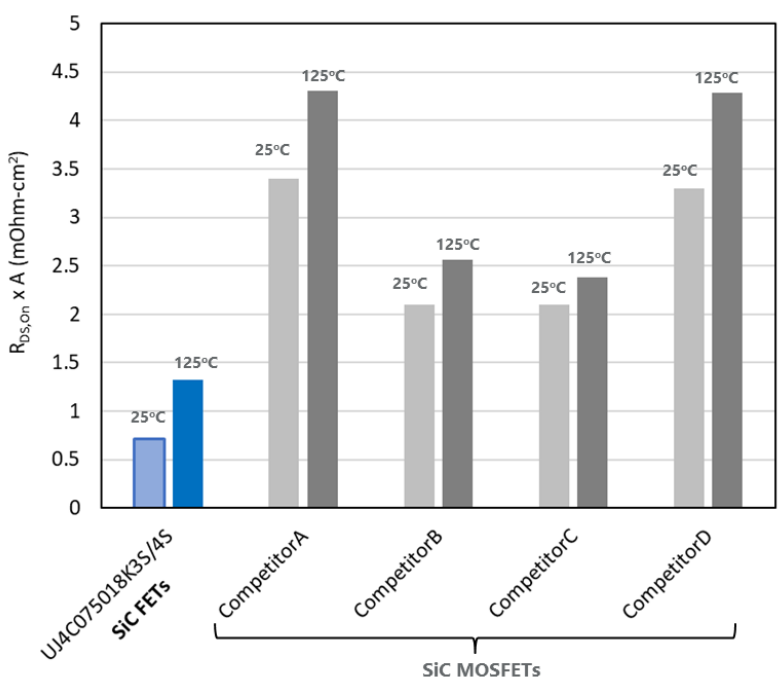

Figure 4. 750V Gen 4 UnitedSiC JFET On-resistance per unit area compared to 650V rated SiC competitors

Design ease-of-use is again featured, as all devices can be safely driven with standard 0V to 12V or 15V gate drive voltage. Good noise margin is maintained with a true 5V threshold voltage. Like previous generations, these new SiC FETs can be operated from all the typical Si IGBT, Si MOSFET and SiC MOSFET drive voltages and include a built-in ESD gate protection clamp.

Along with low on-resistance, these new SiC FETs offer improved efficiency in both hard and soft-switched circuits. In hard-switched circuits such as Totem-Pole PFC or standard 2-level inverters, the low on-resistance per unit-area and low output capacitance along with the near-zero stored charge in the low-voltage Si MOSFET combine to offer superior reverse recovery charge (Q_{rr}) and low E_{oss}/Q_{oss}. The devices exhibit a superior and robust integral diode with low voltage drop V_F (<1.75V).

These SiC FETs also offer improved performance in high-frequency, soft-switched resonant converter topologies such as LLC or PSFB. The breakthrough performance of the 750V devices come as the on-resistance has been substantially reduced, while at the same time, offering lower output capacitance, $C_{oss(tr)}$ for any give $R_{DS(on)}$. The soft-switching Figure-of-Merit (represented as $R_{DS(on)}$ x $C_{oss(tr)}$) advantage is best in class across the full range of useful operating temperature.

The radar plot shown in Figure 4 summarizes the comparative advantage of Gen 4 750V FETs with 650V-750V competitors. The SiC FETs are unmatched when key hard switching and soft-switching parameters are considered. The ultra-low on-resistance per unit area allow standard discrete packages with performance levels not achievable with incumbent Si or emerging WBG competing technologies.

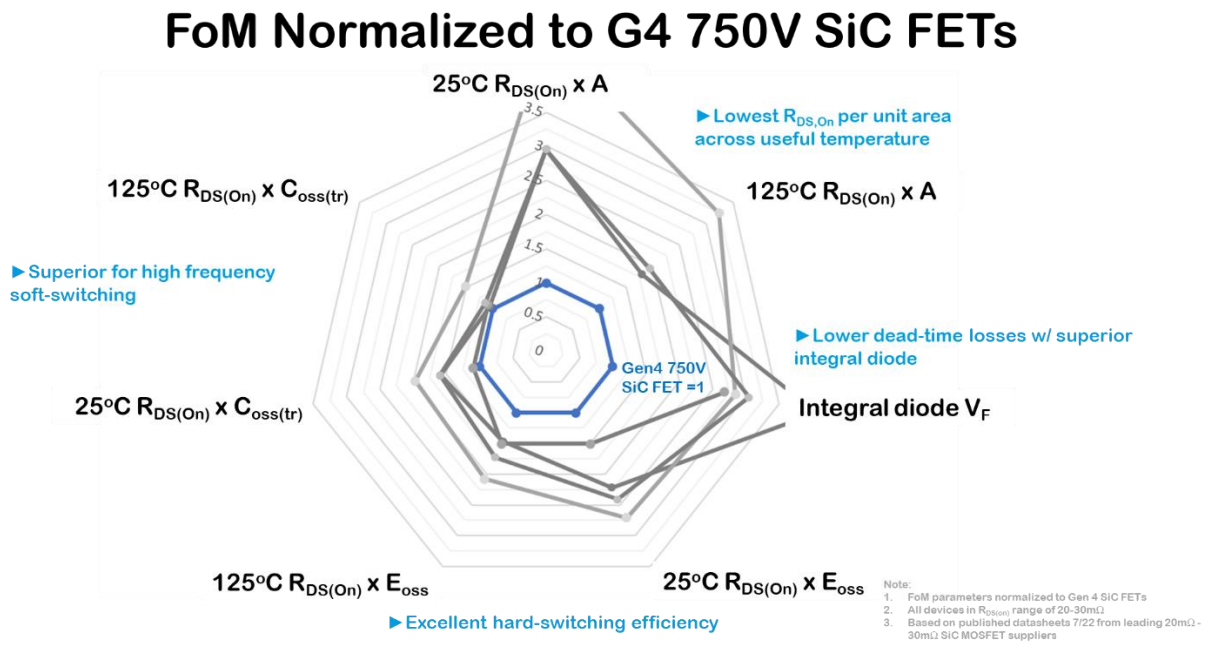

Figure 5. Radar plot of UnitedSiC 750V FETs comparative advantage with key parameters normalized (note: lower values are superior)

In summary, these SiC FETs from UnitedSiC deliver an entirely new level of performance enabled by the advanced Gen 4 technology. UnitedSiC has extended its performance leadership with the lowest $R_{DS(on)}$ 6mOhm SiC FET and provided users with much needed design flexibility with the broadest WBG portfolio in this voltage class. By adding a 750V option, designers now have additional bus voltage headroom. Important performance "Figures of Merit" deliver an overall better performing SiC FET product that power designers can now benefit from in their next-generation system designs.

To learn more about these new devices, visit https://info.unitedsic.com/gen4.