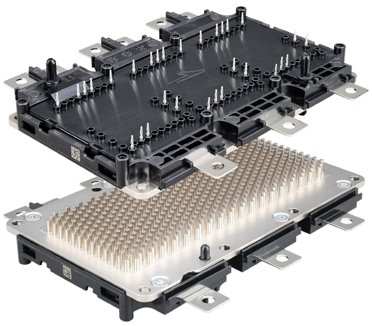
QECB1R6M12YM4, QECB1R6M12YM4L

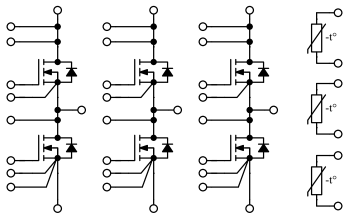
1200 V, 1.6 mΩ, Silicon Carbide, Six-Pack Module

V_{DS}	**1200 V**
$R_{DS(on)}$	**1.6 mΩ**

Technical Features

- Fully SiC MOSFET-Based for Ultra-Low Loss
- Comparative Tracking Index (CTI) > 600
- Extremely low Power Loop Inductance (6.6 nH)
- Limited Extended Operation ($T_{VJ(op)}$ = 200 °C for 100 h)
- High Performance Si_3N_4 Insulator
- Ultra-Reliable Interconnect Technologies
- True Kelvin Connections for Improved Switching
- Planned AQG 324 Qualification





Typical Applications

- Automotive Traction Inverters
- Commercial, Construction, and Agricultural Vehicles
- Hybrid Electric Vehicles
- E-Mobility and Motor Drives
- Auxiliary Power Supplies
- Renewable Energy

System Benefits

- Direct-Cooled Pin Fin Baseplate
- Industry-Standard Footprint
- Press-Fit Connection for Ease of Assembly
- Integrated NTC Temperature Sensors
- Option for Long Phase Terminal to Accommodate Current Sensor

Maximum Parameters (Verified by Design)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Note
Drain-Source Voltage	V_{DS}			1200	V		
Gate-Source Voltage, Maximum Value	$V_{GS(max)}$	-8		+19	V	Transient	Notes 1, 2 Fig. 28
Gate-Source Voltage, Recommended	$V_{GS(op)}$		-4/+15		V	Static	Notes 1, 2 Fig. 28
Implementable Current, Inverter Operation	I_{IMP}		820		A_{RMS}	T_F = 65 °C, F_S = 10 kHz	Fig. 18
DC Continuous Drain Current	I_D		810		A	T_F = 25 °C; V_{GS} = 15 V, Q = 10 l/min, T_{VJ} ≤ 185 °C	Notes 3, 4 Fig. 17
			700			T_F = 65 °C; V_{GS} = 15 V, Q = 10 l/min, T_{VJ} ≤ 185 °C	
Power Dissipation	P_D		1930		W	T_F = 25 °C, Q = 10 l/min, T_{VJ} ≤ 185 °C	Note 5
Virtual Junction Temperature	$T_{VJ(op)}$	-40		185	°C	Continuous operation	
				200		100 hours over lifetime	

Note (1): Recommended turn-on gate voltage is 15 V with ±5 % regulation tolerance
Note (2): $V_{GS(op)}$ of +18 V with $V_{GS(max)}$ of -10/+23 V are permissible for T_{VJ} ≤ 150 °C. Application note available upon request
Note (3): Current limit calculated by $I_{D(max)} = \sqrt{(P_D/R_{DS(typ)}(T_{VJ(max)}))}$
Note (4): Verified by design, limited by packaging and will depend on system architecture implementation
Note (5): $P_D = (T_{VJ} - T_F)/R_{th(JF,typ)}$

4600 Silicon Drive | Durham, NC 27703 | Tel: +1.919.313.5300 | wolfspeed.com/power

MOSFET Characteristics (Per Position) (T_{VJ} = 25 °C Unless Otherwise Specified)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions		Note
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	1200			V	V_{GS} = 0 V, T_{VJ} = -40 °C		
Gate Threshold Voltage	$V_{GS(th)}$	1.8	2.4	3.2	V	T_{VJ} = 25 °C	V_{DS} = V_{GS}, I_D = 163 mA	Fig. 10
			1.8			T_{VJ} = 185 °C		
Zero Gate Voltage Drain Current	I_{DSS}		8	80	µA	V_{GS} = 0 V, V_{DS} = 1200 V		
Gate-Source Leakage Current	I_{GSS}		80	800	nA	V_{GS} = 15 V, V_{DS} = 0 V		
Drain-Source On-State Resistance (Devices Only)	$R_{DS(on)}$		1.6	2.0	mΩ	T_{VJ} = 25 °C	V_{GS} = 15 V, I_D = 600 A	Figs. 2, 3
			2.8			T_{VJ} = 175 °C		
			2.9			T_{VJ} = 185 °C		
			3.2			T_{VJ} = 200 °C		
Transconductance	g_{fs}		480		S	T_{VJ} = 25 °C	V_{DS} = 20 V, I_D = 600 A	Fig. 4
			472			T_{VJ} = 185 °C		
Turn-On Switching Energy	E_{ON}		27.1		mJ	T_{VJ} = 25 °C	V_{DS} = 800V, I_D = 600 A, V_{GS} = -4 V/15 V, $R_{G(ON)}$ = 4.0 Ω, $R_{G(OFF)}$ = 5.0 Ω, $L_σ$ = 16.1 nH	Figs. 12, 13, 14, 25, 26
			23.3			T_{VJ} = 185°C		
			23.3			T_{VJ} = 200°C		
Turn-Off Switching Energy	E_{OFF}		33.6			T_{VJ} = 25 °C		
			32.7			T_{VJ} = 185°C		
			32.7			T_{VJ} = 200°C		
Internal Gate Resistance	$R_{G(int)}$		0.6		Ω	V_{AC} = 25 mV, f = 100 kHz		
Input Capacitance	C_{iss}		53.2		nF	V_{GS} = 0 V, V_{DS} = 800 V, V_{AC} = 25 mV, f = 100 kHz		Fig. 9
Output Capacitance	C_{oss}		1.8					
Reverse Transfer Capacitance	C_{rss}		81		pF			
Gate to Source Charge	Q_{GS}		528		nC	V_{DS} = 800 V, V_{GS} = -4 V/15 V, I_D = 600 A, per IEC60747-8-4		
Gate to Drain Charge	Q_{GD}		488					
Total Gate Charge	Q_G		1936					
Thermal Resistance, Junction to Fluid	$R_{th(JF)}$		0.083		°C/W	Single switch, Q = 10 l/min, T_F = 60 °C		Fig. 16

Diode Characteristics (Per Position) (T_{VJ} = 25 °C Unless Otherwise Specified)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions		Note
Body Diode Forward Voltage	V_{SD}		6.3		V	T_{VJ} = 25 °C	V_{GS} = -4 V, I_{SD} = 600 A	Fig. 7
			5.5			T_{VJ} = 185 °C		
Reverse Recovery Time	t_{RR}		177		ns	V_{GS} = -4 V, I_{SD} = 600 A, V_R = 800 V di/dt = 13.6 A/ns, T_{VJ} = 185 °C		Fig. 27
Reverse Recovery Charge	Q_{RR}		17.1		µC			
Peak Reverse Recovery Current	I_{RRM}		337		A			
Reverse Recovery Energy	E_{RR}		1.5		mJ	T_{VJ} = 25 °C	V_{DS} = 800 V, I_D = 600 A, V_{GS} = -4 V/15 V, $R_{G(ON)}$ = 4.0 Ω, $L_σ$ = 16.1 nH	Figs. 12, 13, 14
			8.6			T_{VJ} = 185 °C		
			10.3			T_{VJ} = 200 °C		

Module Physical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Note
Package Resistance, High-Side	$R_{pkg(HS)}$		0.30		mΩ	T_F = 25 °C	Note 6
Package Resistance, Low-Side	$R_{pkg(LS)}$		0.22		mΩ	T_F = 25 °C	Note 6
Baseplate Material			Cu+Ni				
Internal Isolator Material			Si_3N_4			Basic insulation (class 1, IEC 61140)	
Stray Inductance	L_{stray}		6.6		nH	Between DC+ and DC-, f = 10 MHz	
Storage Temperature	T_{stg}	-40		125	°C		
Weight	W		805		g		
Maximum Pressure in Cooling Circuit	p			2.5	bar		
Mounting Torque	M_S	1.8		2.2	N·m	Baseplate, M4 bolts	
		3.6		4.4	N·m	Power terminals, M5 bolts	
Case Isolation Voltage	V_{isol}	4.2			kV	DC, t = 1 s	
Comparative Tracking Index	CTI	600					
Clearance Distance		4.3			mm	Terminal to terminal	
		4.5			mm	Terminal to heatsink	
Creepage Distance		9.2			mm	Terminal to terminal	
		9.8			mm	Terminal to heatsink	

Note (6): Total effective resistance (per switch position) = MOSFET $R_{DS(on)}$ + switch position package resistance

Temperature Sensor (NTC) Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Note
Resistance at 25 °C	R_{25}	4.75	5.00	5.25	kΩ	T_{NTC} = 25 °C	
Tolerance of R_{100}	ΔR/R	-9.22		9.89	%	T_{NTC} = 100 °C, R_{100} = 493.3 Ω	
Beta Value for 25°C to 50°C	$B_{25/50}$	3307	3375	3443	K		
Beta Value for 25°C to 80°C	$B_{25/80}$	3346	3414	3482	K		
Beta Value for 25°C to 100°C	$B_{25/100}$	3368	3436	3503	K		
Maximum Power Dissipation	P_{25}		1.4		mW		

Typical Performance

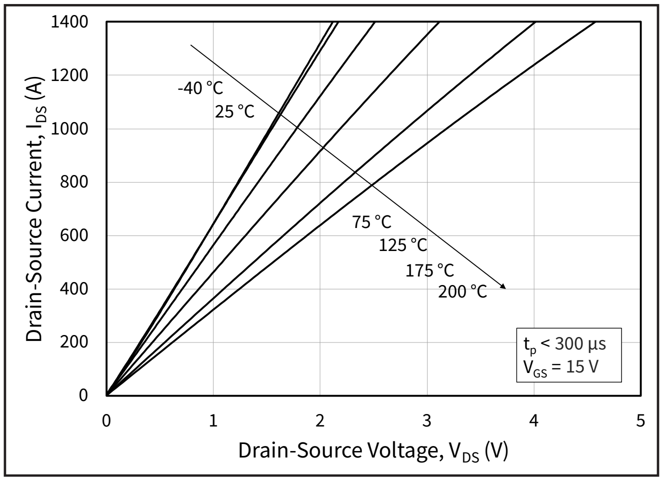


Figure 1. Output Characteristics for Various Junction Temperatures

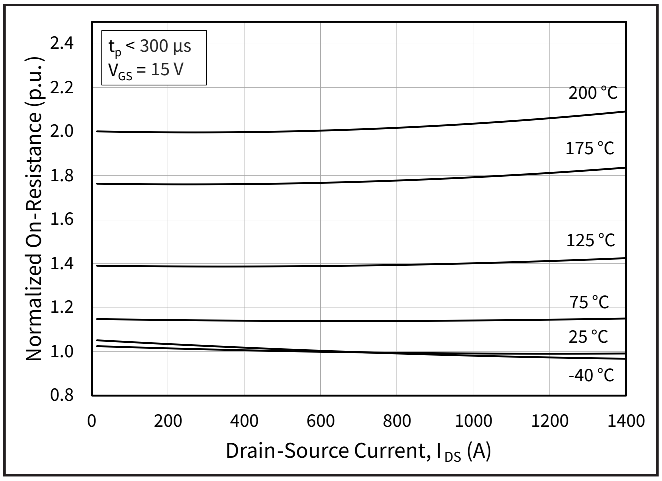


Figure 2. Normalized On-State Resistance vs. Drain Current for Various Junction Temperatures

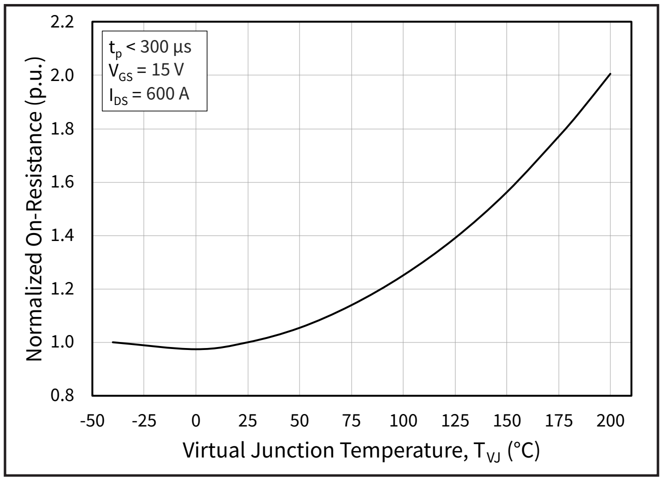


Figure 3. Normalized On-State Resistance vs. Junction Temperature

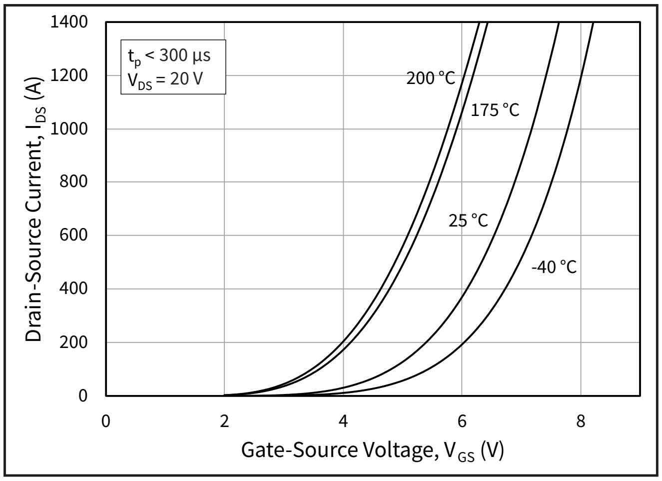


Figure 4. Transfer Characteristic for Various Junction Temperatures

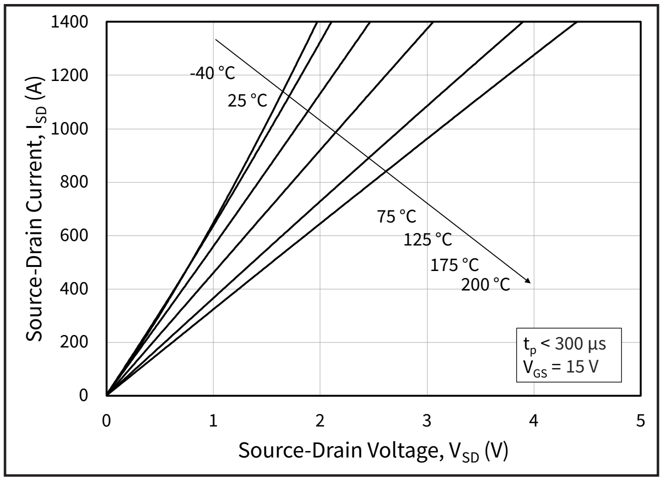


Figure 5. 3rd Quadrant Characteristic vs. Junction Temperatures at V_{GS} = 15 V

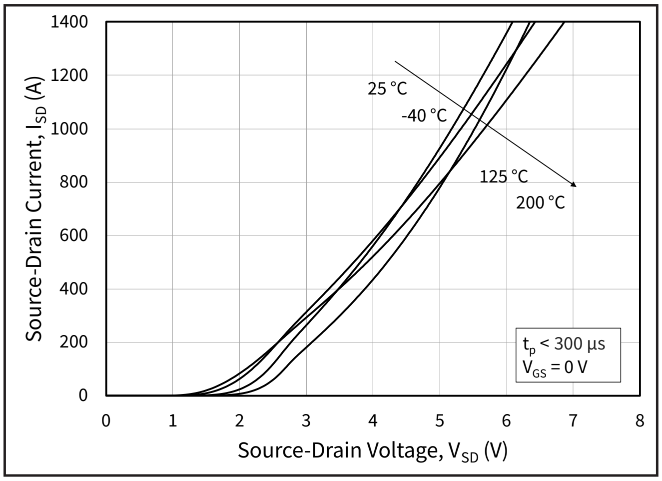


Figure 6. 3rd Quadrant Characteristic vs. Junction Temperatures at V_{GS} = 0 V (Body Diode)

Typical Performance

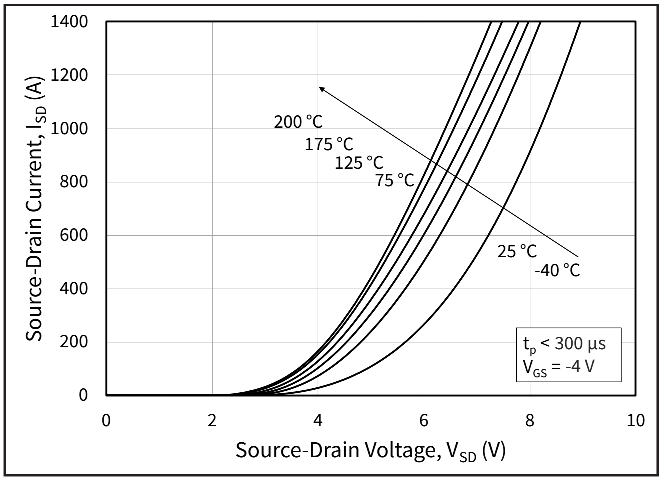


Figure 7. 3rd Quadrant Characteristic vs. Junction Temperatures at V_{GS} = -4 V (Body Diode)

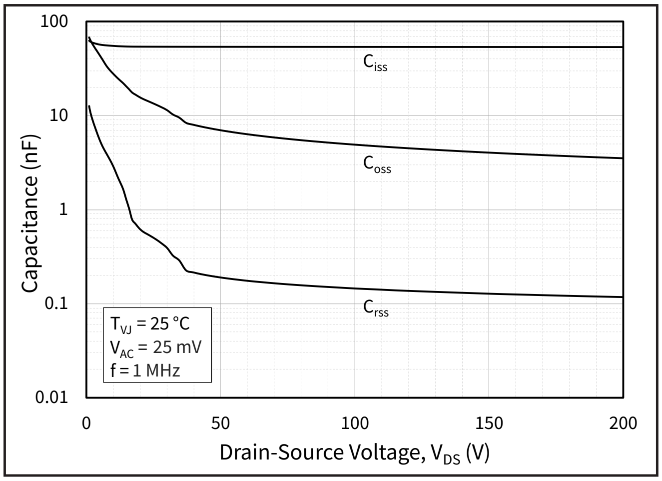


Figure 8. Typical Capacitances vs. Drain to Source Voltage (0 - 200 V)

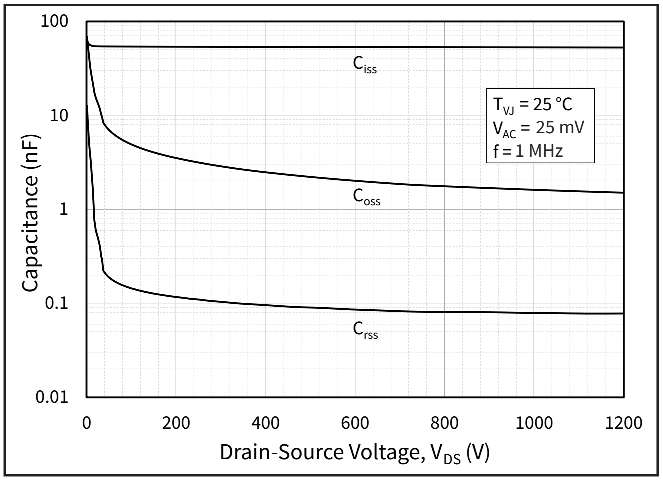


Figure 9. Typical Capacitances vs. Drain to Source Voltage (0 - 1200V)

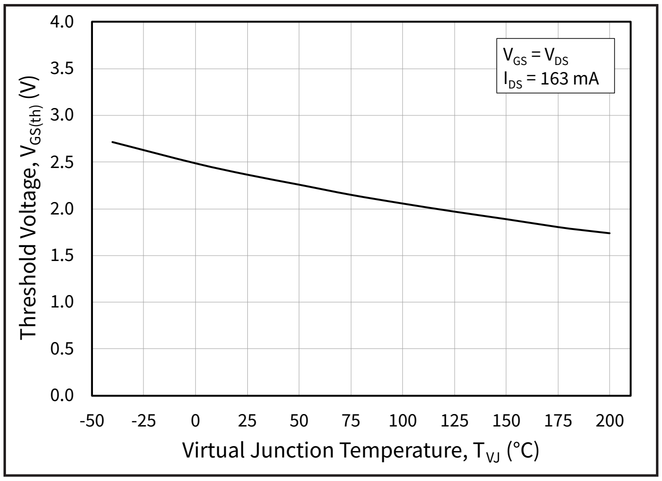


Figure 10. Threshold Voltage vs. Junction Temperature

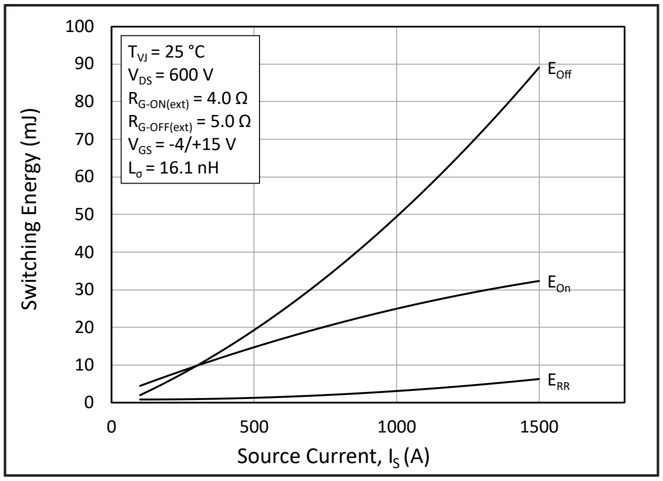


Figure 11. Switching Energy vs. Drain Current (V_{DS} = 600 V)

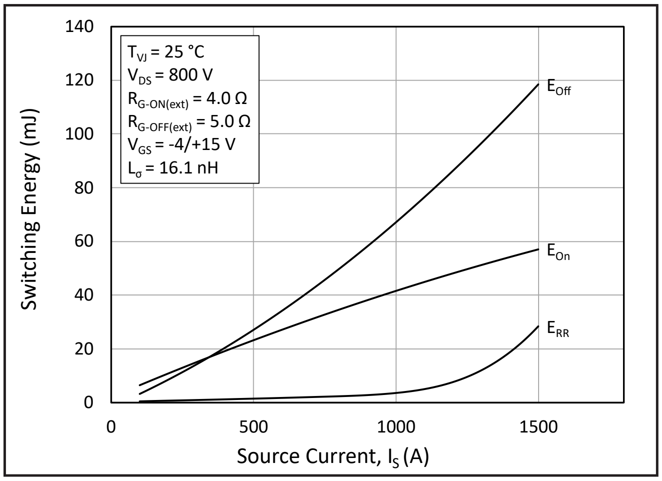


Figure 12. Switching Energy vs. Drain Current (V_{DS} = 800 V)

Typical Performance

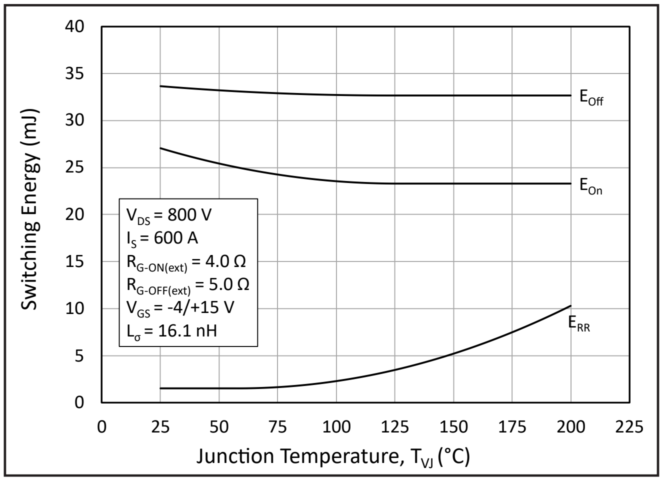


Figure 13. Switching Energy vs. Junction Temperature

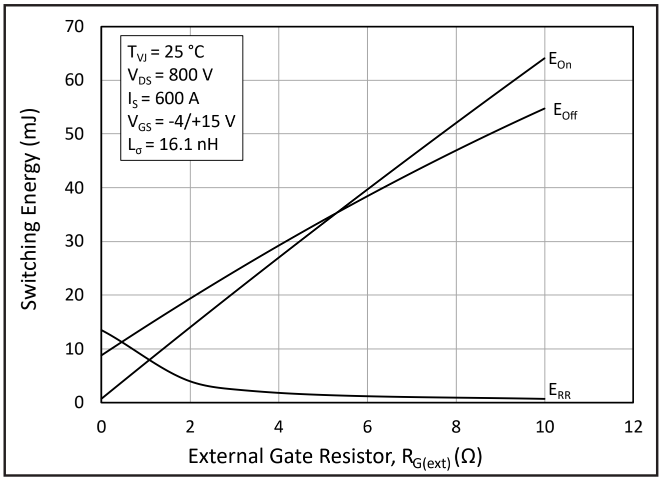


Figure 14. Switching Energy vs. External Gate Resistance

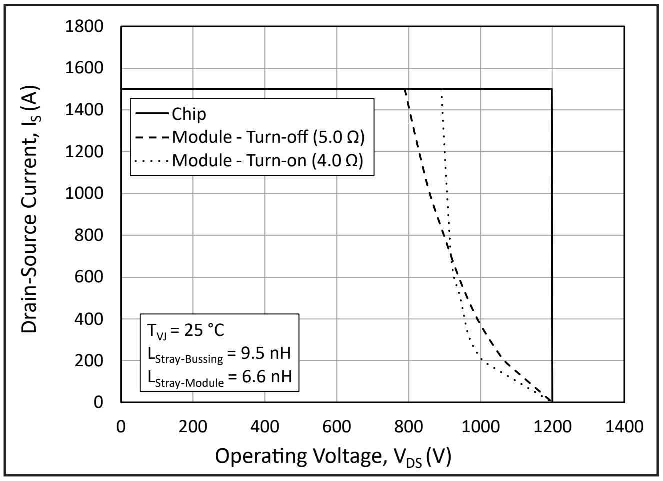


Figure 15. Switching Safe Operating Area

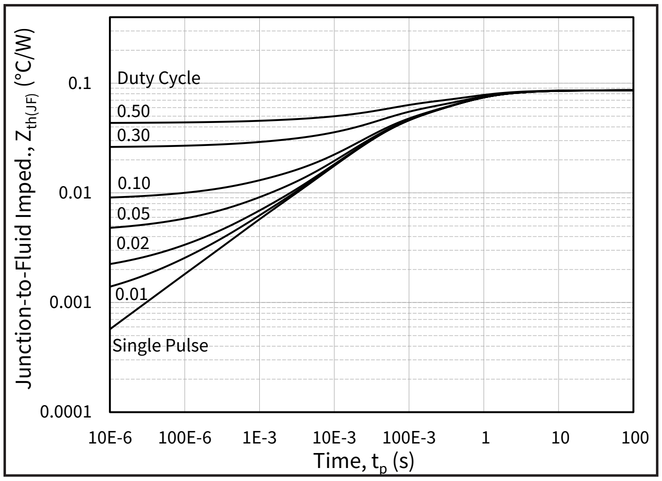


Figure 16. Junction to Fluid Transient Thermal Impedance

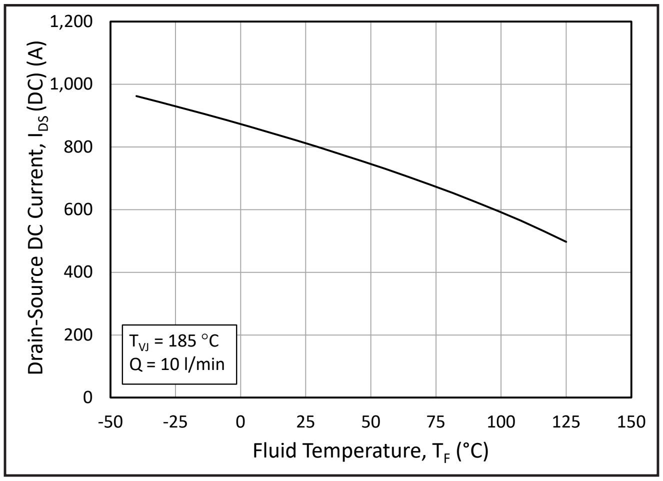


Figure 17. Continuous Drain Current Derating vs. Fluid Temperature

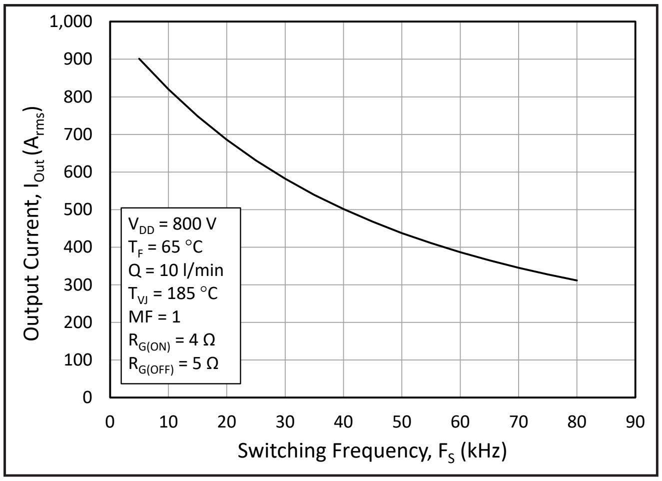


Figure 18. Typical Output Current Capability vs. Switching Frequency (Inverter Application)

Typical Performance

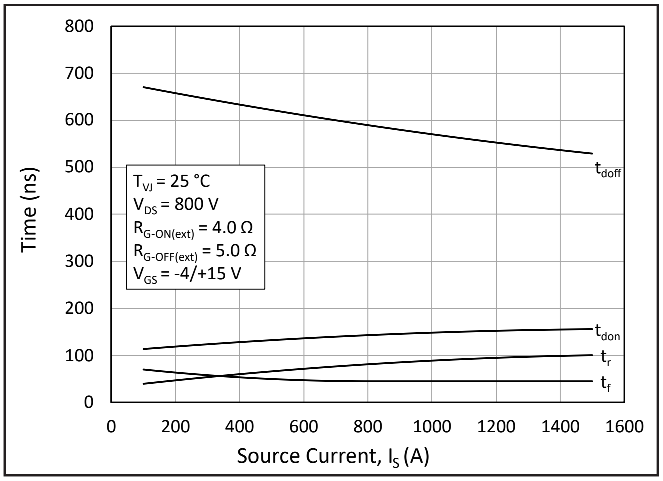


Figure 19. Timing vs. Source Current

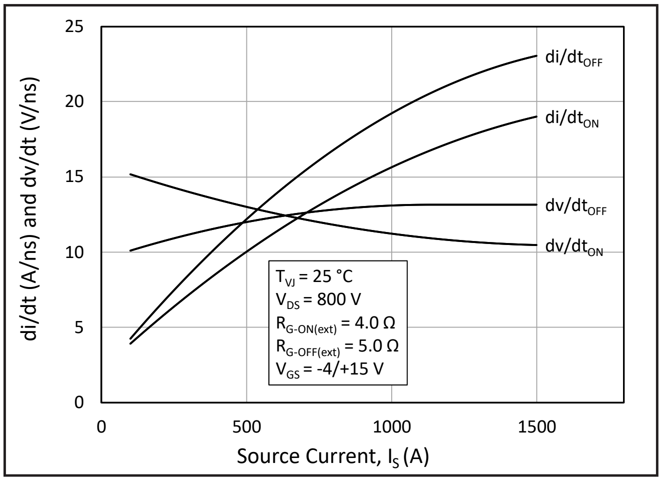


Figure 20. dv/dt and di/dt vs. Source Current

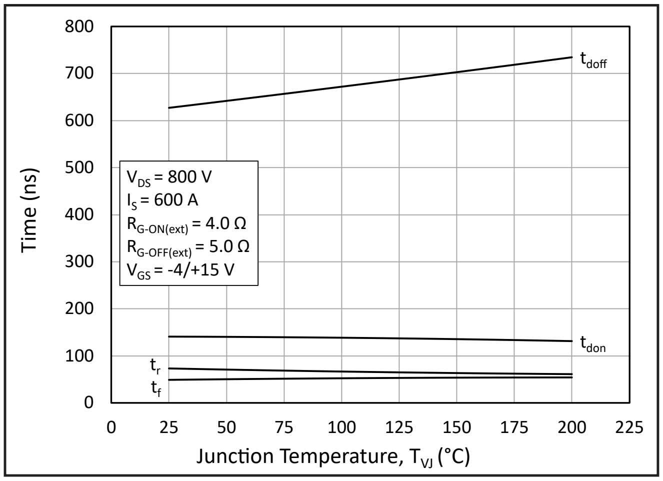


Figure 21. Timing vs. Junction Temperature

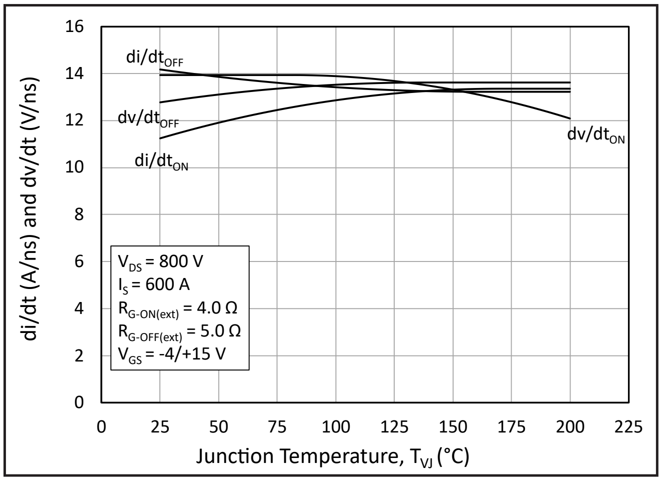


Figure 22. dv/dt and di/dt vs. Junction Temperature

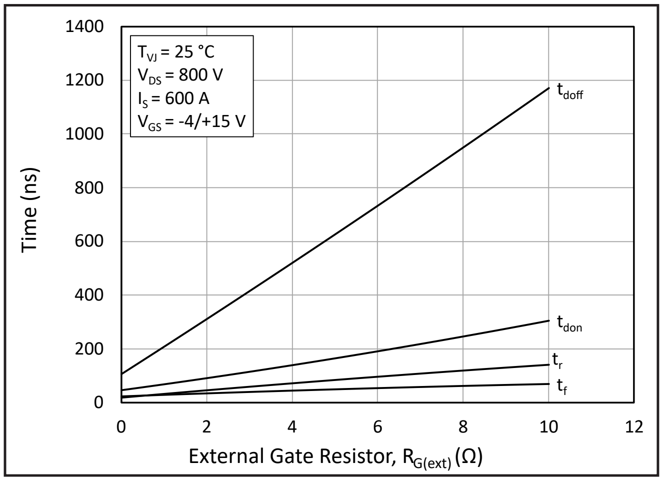


Figure 23. Timing vs. External Gate Resistance

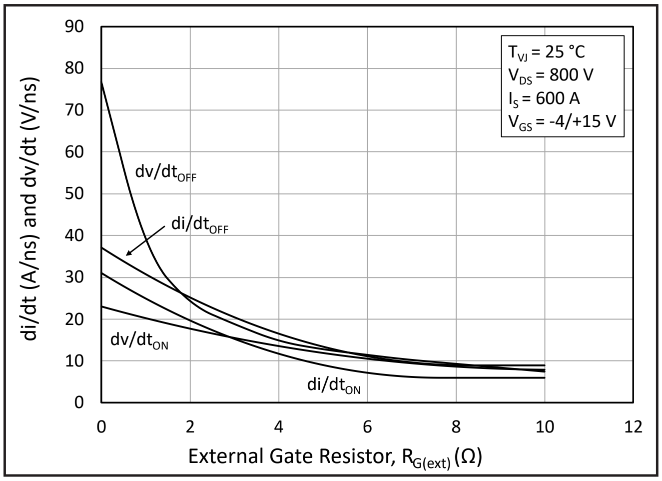


Figure 24. dv/dt and di/dt vs. External Gate Resistance

Definitions

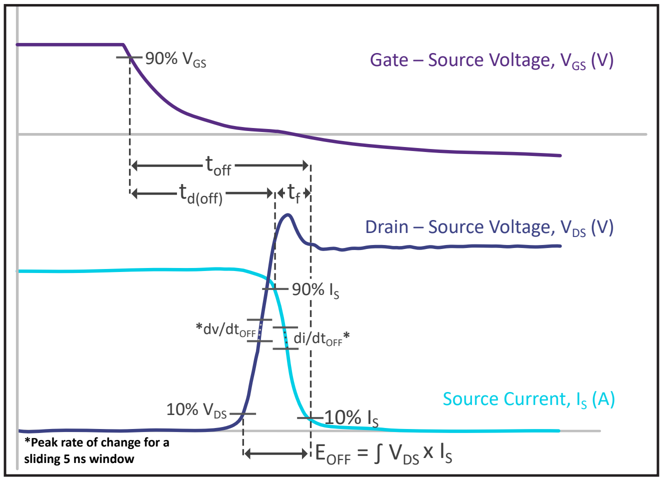


Figure 25. Turn-Off Transient Definitions

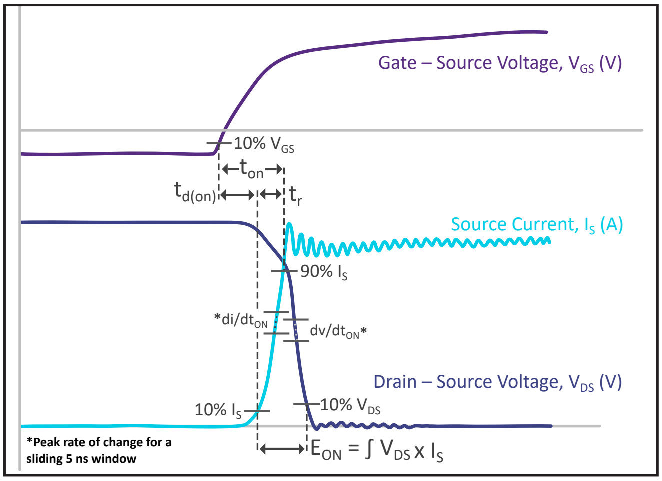


Figure 26. Turn-On Transient Definitions

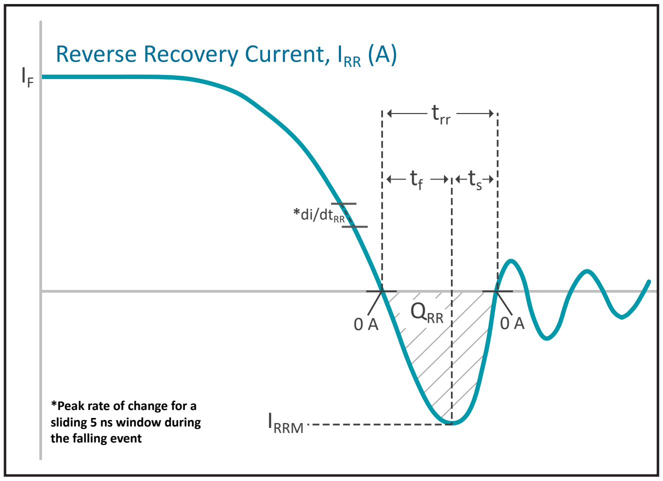


Figure 27. Reverse Recovery Definitions

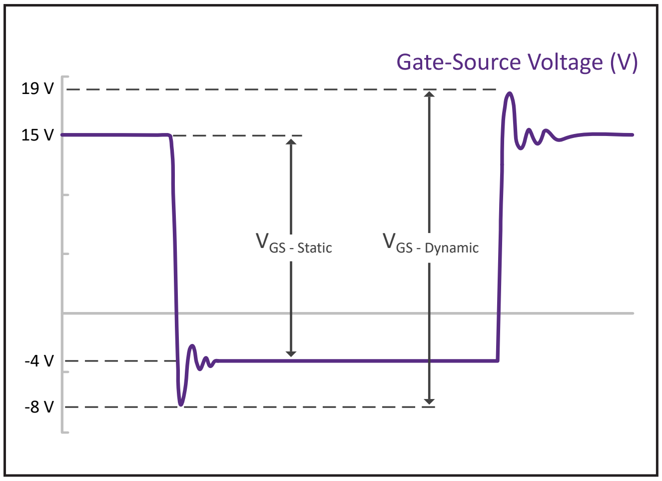
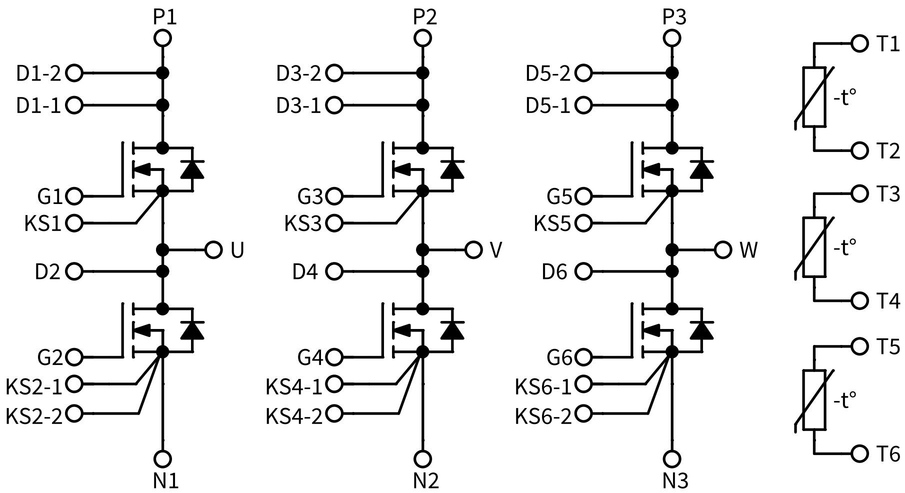


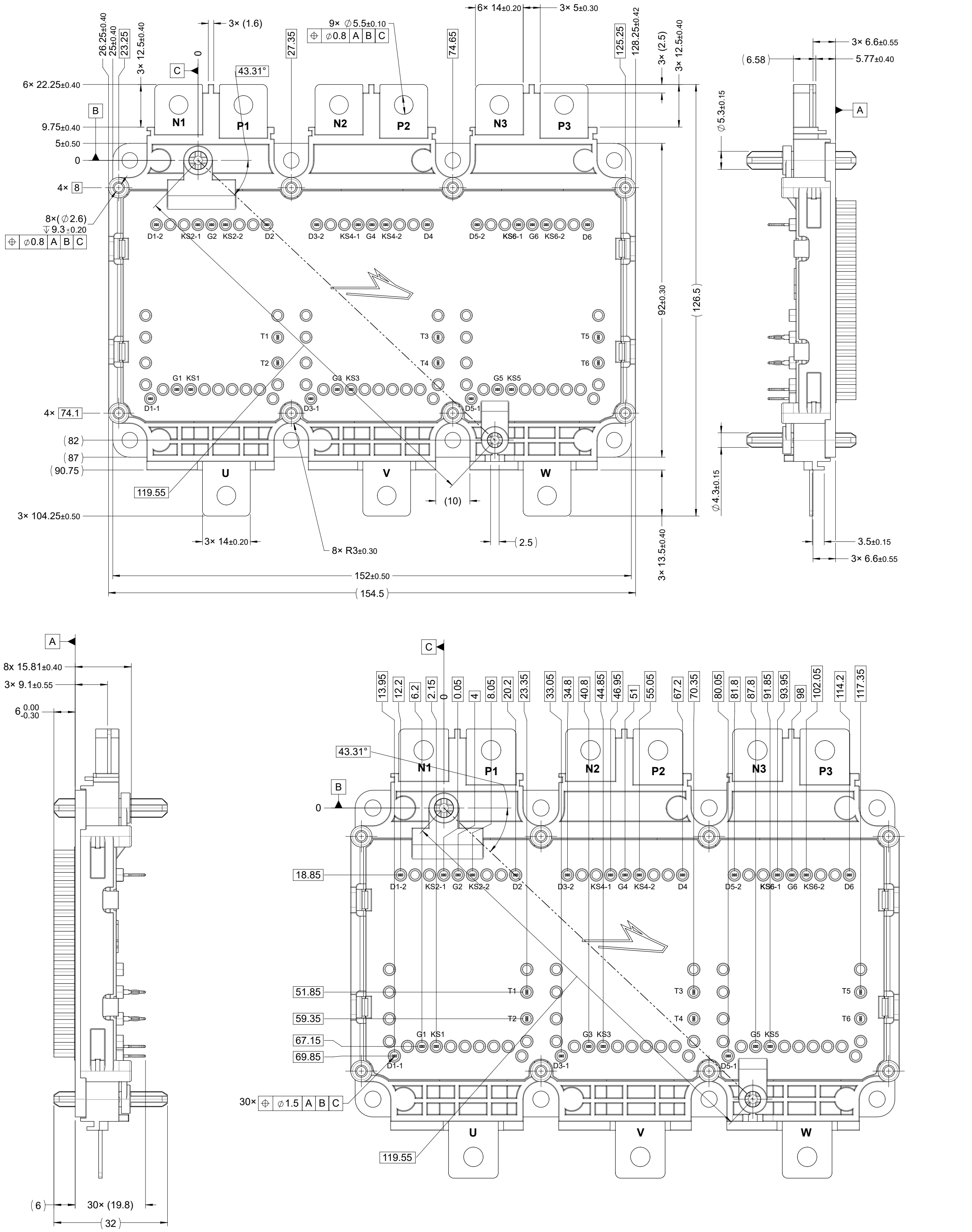
Figure 28. V_{GS} Transient Definitions

Note: A gate driver featuring the IXDD614SI gate driver IC was used to evaluate dynamic performance. The typical driver high-state output resistance of 0.4 Ω and low-state output resistance of 0.3 Ω are not included in the $R_{G(ext)}$ values on this datasheet.

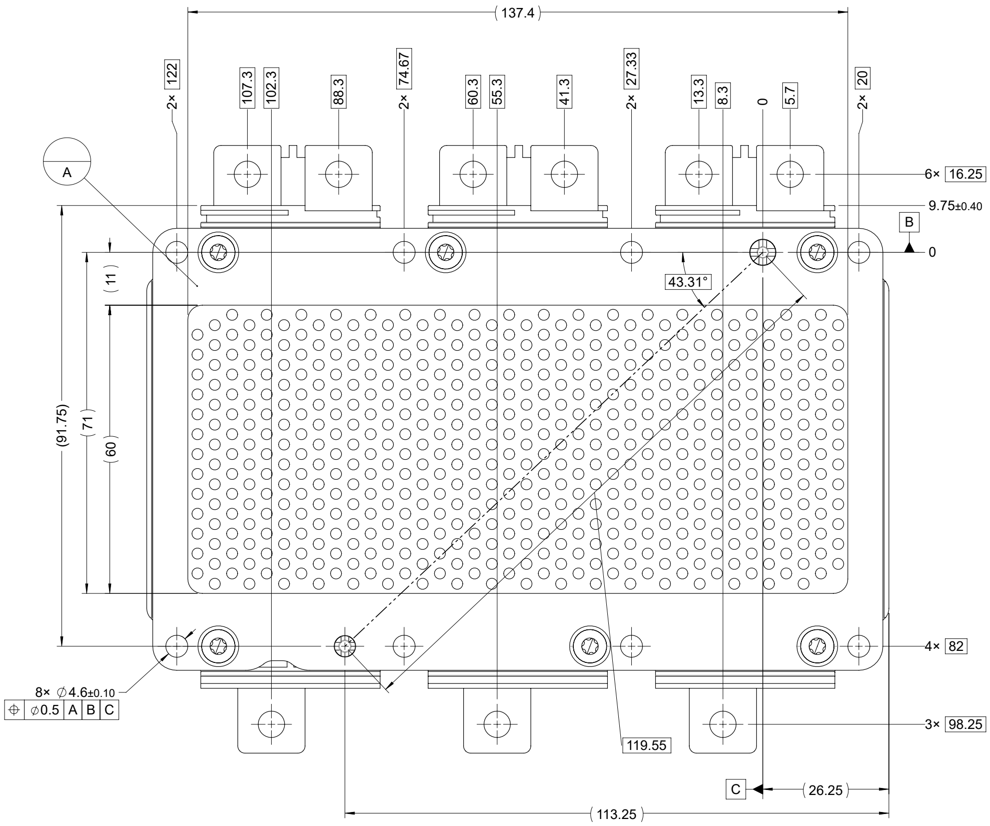
Schematic and Pin Out



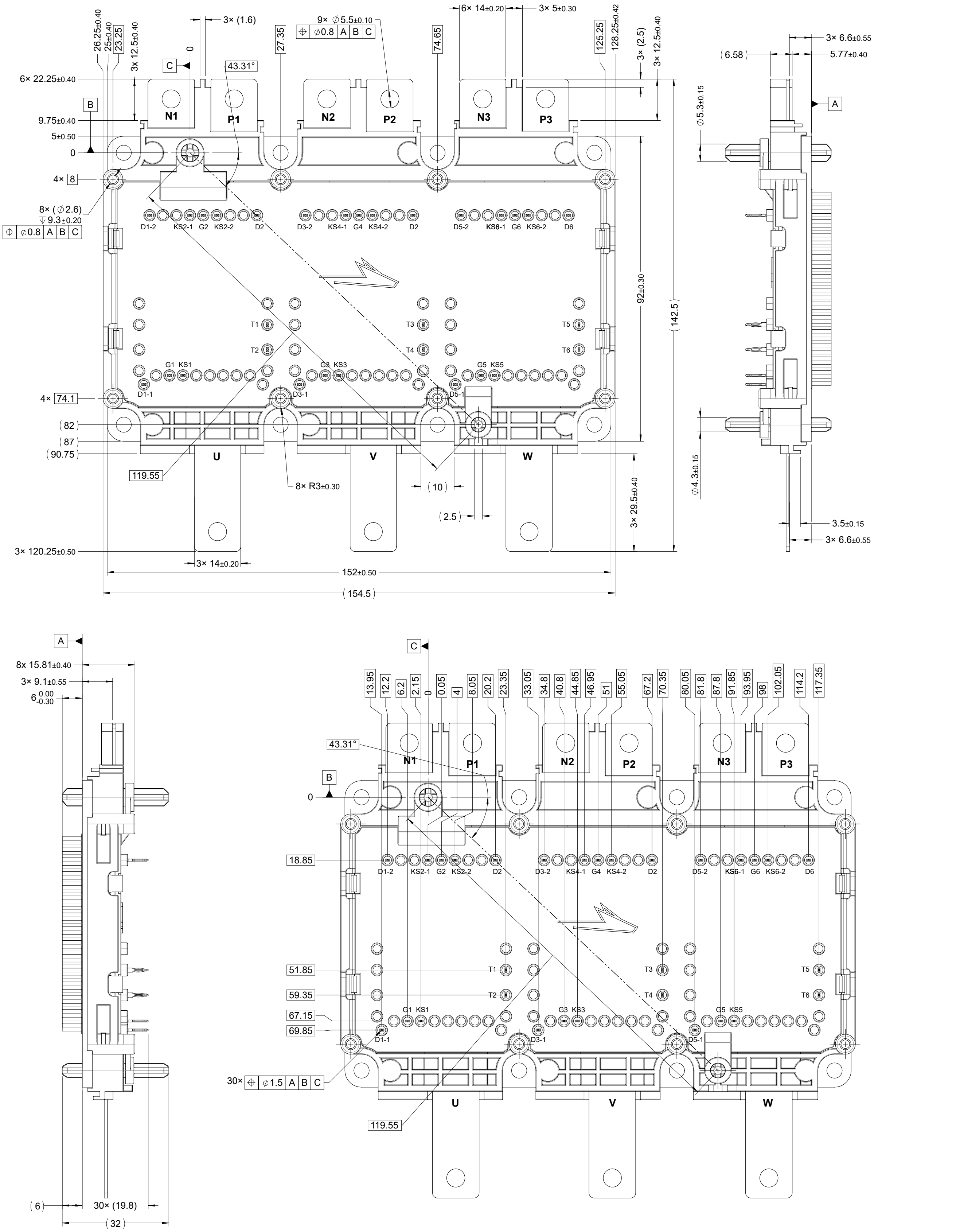
Package Dimensions (mm), QECB1R6M12YM4



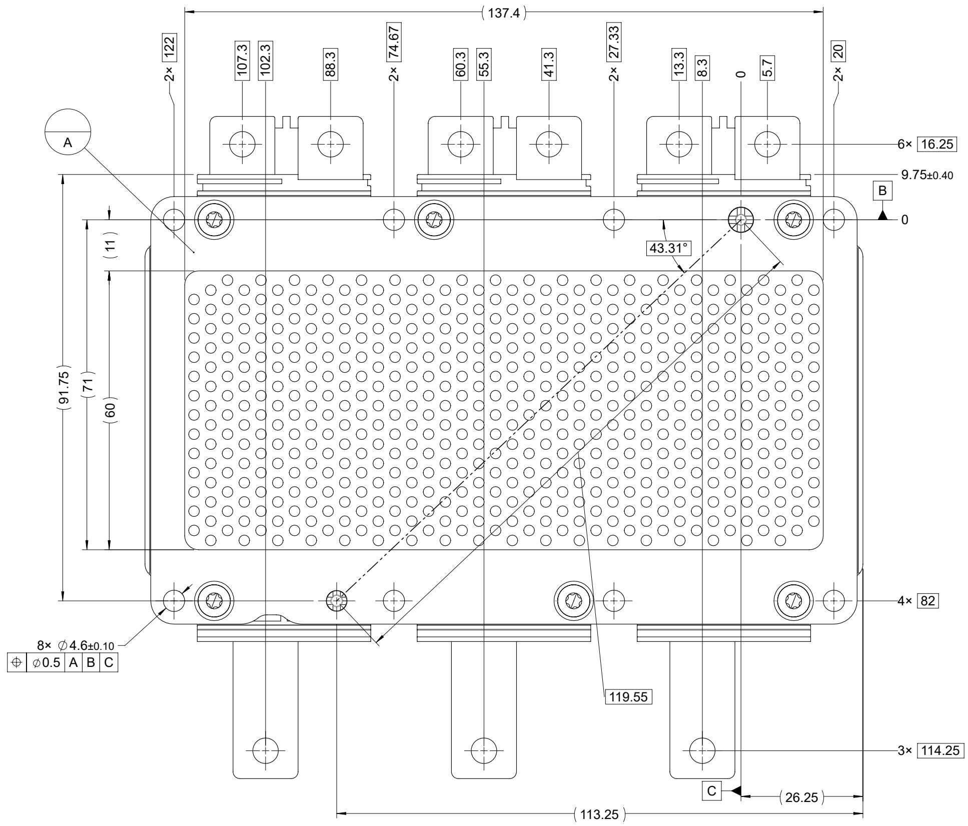
Package Dimensions (mm), QECB1R6M12YM4, Continued



Package Dimensions (mm), QECB1R6M12YM4L



Package Dimensions (mm), QECB1R6M12YM4L, Continued



Product Ordering Code

Part Number	Description
QECB1R6M12YM4	1200 V, 1.6 mΩ, Silicon Carbide, Six-Pack Module, Short Phase Terminal
QECB1R6M12YM4L	1200 V, 1.6 mΩ, Silicon Carbide, Six-Pack Module, Long Phase Terminal

Revision History

Revision History	Date	Brief Summary
Rev. A	November 2025	Initial prerelease

Supporting Links & Tools

Evaluation Tools & Support

- SpeedFit 2.0 Design Simulator™
- Technical Support Forum
- LTspice and PLECS Models
- KIT-CRD-CIL12N-YMC: Dynamic Performance Evaluation Board for the YM3 Six-pack Module

Dual-Channel Gate Driver Board

- CGD12HB00D: Differential Transceiver Daughter Board Companion Tool for Differential Gate Drivers
- CGD1700HB2M-UNA: Wolfspeed Gate Driver Board
- EVAL-ADUM4146WHB1Z: Analog Devices® Gate Driver Board
- UCC21710QDWEVM-054: Texas Instruments® Gate Driver Board
- NXP EV Traction Inverter Control Reference Design Gen 3

Application Notes

- PRD-04814: Design Options for Wolfspeed® Silicon Carbide MOSFET Gate Bias Power Supplies
- PRD-06379: Environmental Considerations for Power Electronics Systems
- PRD-08333: Wolfspeed Module CIL Evaluation Kits User Guide
- PRD-08376: Thermal Characterization Methods and Applications
- PRD-07845: Power Module Baseplate Capacitance and Electromagnetic Compatibility
- PRD-08710: Measuring Stray Inductance in Power Electronics Systems
- PRD-08911: Considerations for Current Balancing in Paralleled SiC Power Modules
- PRD-09035: Power Module RC Thermal Models User Guide

Notes & Disclaimers

WOLFSPEED PROVIDES TECHNICAL AND RELIABILITY DATA, DESIGN RESOURCES, APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, WITH RESPECT THERETO, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, SUITABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS.

This document and the information contained herein are subject to change without notice. Any such change shall be evidenced by the publication of an updated version of this document by Wolfspeed. No communication from any employee or agent of Wolfspeed or any third party shall effect an amendment or modification of this document. No responsibility is assumed by Wolfspeed for any infringement of patents or other rights of third parties which may result from use of the information contained herein. No license is granted by implication or otherwise under any patent or patent rights of Wolfspeed.

The information contained in this document (excluding examples, as well as figures or values that are labeled as “typical”) constitutes Wolfspeed’s sole published specifications for the subject product. “Typical” parameters are the average values expected by Wolfspeed in large quantities and are provided for informational purposes only. Any examples provided herein have not been produced under conditions intended to replicate any specific end use. Product performance can and does vary due to a number of factors.

This product has not been designed or tested for use in, and is not intended for use in, any application in which failure of the product would reasonably be expected to cause death, personal injury, or property damage. For purposes of (but without limiting) the foregoing, this product is not designed, intended, or authorized for use as a critical component in equipment implanted into the human body, life-support machines, cardiac defibrillators, and similar emergency medical equipment; air traffic control systems; or equipment used in the planning, construction, maintenance, or operation of nuclear facilities. Notwithstanding any application-specific information, guidance, assistance, or support that Wolfspeed may provide, the buyer of this product is solely responsible for determining the suitability of this product for the buyer’s purposes, including without limitation (1) selecting the appropriate Wolfspeed products for the buyer’s application, (2) designing, validating, and testing the buyer’s application, and (3) ensuring the buyer’s application meets applicable standards and any other legal, regulatory, and safety-related requirements.

RoHS Compliance

The levels of RoHS restricted materials in this product are below the maximum concentration values (also referred to as the threshold limits) permitted for such substances, or are used in an exempted application, in accordance with EU Directive 2011/65/EC (RoHS2), as implemented January 2, 2013. RoHS Declarations for this product can be obtained from your Wolfspeed representative or from the Product Documentation sections of www.wolfspeed.com.

REACh Compliance

REACh substances of high concern (SVHCs) information is available for this product. Since the European Chemical Agency (ECHA) has published notice of their intent to frequently revise the SVHC listing for the foreseeable future, please contact your Wolfspeed representative to ensure you get the most up-to-date REACh SVHC Declaration. REACh banned substance information (REACh Article 67) is also available upon request.

Contact info:

4600 Silicon Drive
Durham, NC 27703 USA
Tel: +1.919.313.5300
www.wolfspeed.com/power