

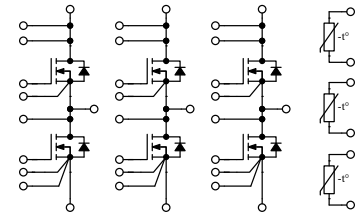
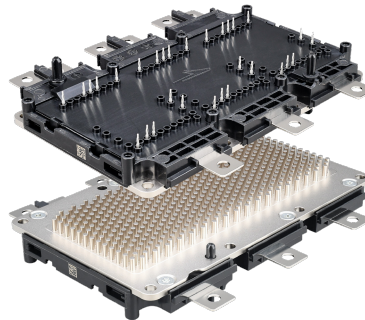
# QE CB2R1M12YM4, QE CB2R1M12YM4L

1200 V, 2.1 mΩ, Silicon Carbide, Six-Pack Module

$V_{DS}$	<b>1200 V</b>
$R_{DS(on)}$	<b>2.1 mΩ</b>

## 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 ( $T_{VJ(op)} = 200\text{ °C}$  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			
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			Static	
Implementable Current, Inverter Operation	$I_{IMP}$		650		$A_{RMS}$	$T_F = 65\text{ °C}$ , $F_S = 10\text{ kHz}$	Fig. 18
DC Continuous Drain Current	$I_D$		630		A	$T_F = 25\text{ °C}$	Notes 3, 4 Fig. 17
			540			$T_F = 65\text{ °C}$	
Power Dissipation	$P_D$		1520		W	$T_F = 25\text{ °C}$ , $Q = 10\text{ l/min}$ , $T_{VJ} \leq 185\text{ °C}$	Note 4
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  $\pm 5\%$  regulation tolerance

Note (2):  $V_{GS(op)}$  of +18 V with  $V_{GS(max)}$  of -10/+23 V are permissible for  $T_{VJ} \leq 150\text{ °C}$ . 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):  $P_D = (T_{VJ} - T_F)/R_{th(JF,typ)}$



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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Note
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	1200				$V_{GS} = 0\text{ V}, T_{VJ} = -40\text{ °C}$	
Gate Threshold Voltage	$V_{GS(th)}$	1.8	2.4	3.2	V	$T_{VJ} = 25\text{ °C}$ $T_{VJ} = 185\text{ °C}$ $V_{DS} = V_{GS}, I_D = 122\text{ mA}$	Fig. 10
Zero Gate Voltage Drain Current	$I_{DSS}$		6	60	$\mu\text{A}$	$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}$	
Gate-Source Leakage Current	$I_{GSS}$		60	600	nA	$V_{GS} = 15\text{ V}, V_{DS} = 0\text{ V}$	
Drain-Source On-State Resistance (Devices Only)	$R_{DS(on)}$		2.1	2.6	m $\Omega$	$T_{VJ} = 25\text{ °C}$	Figs. 2, 3
			3.7			$T_{VJ} = 175\text{ °C}$	
			3.9			$T_{VJ} = 185\text{ °C}$	
			4.2			$T_{VJ} = 200\text{ °C}$	
Transconductance	$g_{fs}$		360		S	$T_{VJ} = 25\text{ °C}$ $T_{VJ} = 185\text{ °C}$ $V_{DS} = 20\text{ V}, I_D = 450\text{ A}$	Fig. 4
Turn-On Switching Energy	$E_{ON}$		19.6		mJ	$T_{VJ} = 25\text{ °C}$	Figs. 12, 13, 14, 25, 26
			16.9			$T_{VJ} = 185\text{ °C}$	
			TBD			$T_{VJ} = 200\text{ °C}$	
Turn-Off Switching Energy	$E_{OFF}$		26.0		mJ	$T_{VJ} = 25\text{ °C}$	
			24.7			$T_{VJ} = 185\text{ °C}$	
			TBD			$T_{VJ} = 200\text{ °C}$	
Internal Gate Resistance	$R_{G(int)}$		0.8		$\Omega$	$V_{AC} = 25\text{ mV}, f = 100\text{ kHz}$	
Input Capacitance	$C_{iss}$		39.9		nF	$V_{GS} = 0\text{ V}, V_{DS} = 800\text{ V}, V_{AC} = 25\text{ mV}, f = 100\text{ kHz}$	Fig. 9
Output Capacitance	$C_{oss}$		1.3				
Reverse Transfer Capacitance	$C_{rss}$		61		pF		
Gate to Source Charge	$Q_{GS}$		396		nC	$V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}, I_D = 450\text{ A}, \text{ per IEC60747-8-4}$	
Gate to Drain Charge	$Q_{GD}$		366				
Total Gate Charge	$Q_G$		1452				
Thermal Resistance, Junction to Fluid	$R_{th(JF)}$		0.105		$\text{°C}/\text{W}$	Single switch, $Q = 10\text{ l}/\text{min}, T_F = 60\text{ °C}$	Fig. 16



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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Note
Body Diode Forward Voltage	$V_{SD}$		6.3		V	$T_{VJ} = 25\text{ °C}$	Fig. 7
			5.5			$T_{VJ} = 185\text{ °C}$	
Reverse Recovery Time	$t_{RR}$		TBD		ns	$V_{GS} = -4\text{ V}$ , $I_{SD} = 500\text{ A}$ , $V_R = 800\text{ V}$ $di/dt = \text{TBD A/ns}$ , $T_{VJ} = 185\text{ °C}$	Fig. 27
Reverse Recovery Charge	$Q_{RR}$		TBD		$\mu\text{C}$		
Peak Reverse Recovery Current	$I_{RRM}$		TBD		A		
Reverse Recovery Energy	$E_{RR}$		0.9		mJ	$T_{VJ} = 25\text{ °C}$	Figs. 12, 13, 14
			4.8			$T_{VJ} = 185\text{ °C}$	
			TBD			$T_{VJ} = 200\text{ °C}$	



### Module Physical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Note
Package Resistance, High-Side	$R_{pkg(HS)}$		0.30		m $\Omega$	$T_F = 25^\circ\text{C}$	Note 5
Package Resistance, Low-Side	$R_{pkg(LS)}$		0.22				
Baseplate Material			Cu+Ni				
Internal Isolator Material			$\text{Si}_3\text{N}_4$			Basic insulation (class 1, IEC 61140)	
Stray Inductance	$L_{stray}$		6.6		nH	Between DC+ and DC-, $f = 10\text{ MHz}$	
Storage Temperature	$T_{stg}$	-40		125	$^\circ\text{C}$		
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		Power terminals, M5 bolts	
Case Isolation Voltage	$V_{isol}$	4.2			kV	DC, $t = 1\text{ s}$	
Comparative Tracking Index	CTI	600					
Clearance Distance		4.3			mm	Terminal to terminal	
		4.5				Terminal to heatsink	
Creepage Distance		9.2				Terminal to terminal	
		9.8				Terminal to heatsink	

Note (5): 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 $^\circ\text{C}$	$R_{25}$	4.75	5.00	5.25	k $\Omega$	$T_{NTC} = 25^\circ\text{C}$	
Tolerance of $R_{100}$	$\Delta R/R$	-9.22		9.89	%	$T_{NTC} = 100^\circ\text{C}$ , $R_{100} = 493.3\ \Omega$	
Beta Value for 25 $^\circ\text{C}$ to 50 $^\circ\text{C}$	$B_{25/50}$	3307	3375	3443	K		
Beta Value for 25 $^\circ\text{C}$ to 80 $^\circ\text{C}$	$B_{25/80}$	3346	3414	3482			
Beta Value for 25 $^\circ\text{C}$ to 100 $^\circ\text{C}$	$B_{25/100}$	3368	3436	3503			
Maximum Power Dissipation	$P_{25}$		1.4		mW		



Typical Performance

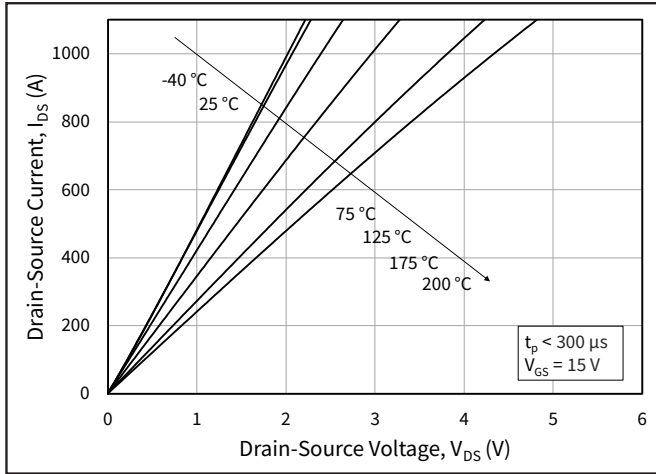


Figure 1. Output Characteristics for Various Junction Temperatures

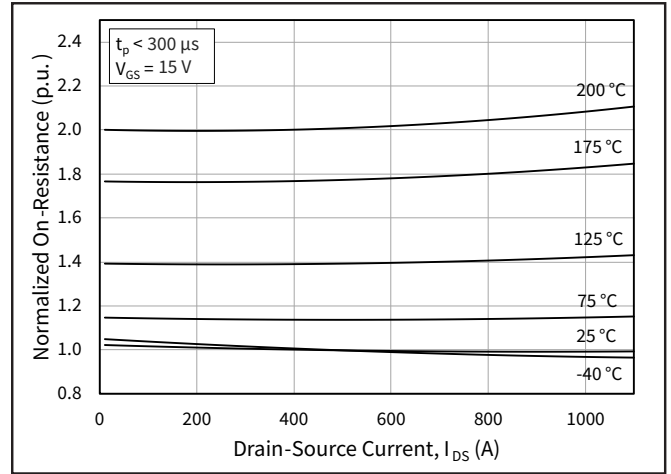


Figure 2. Normalized On-State Resistance vs. Drain Current for Various Junction Temperatures

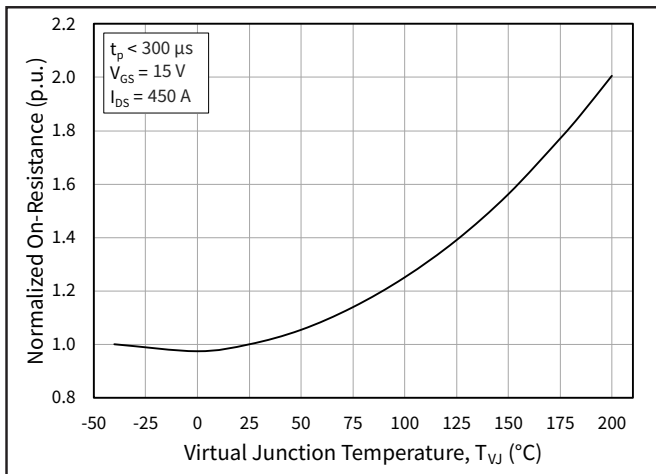


Figure 3. Normalized On-State Resistance vs. Junction Temperature

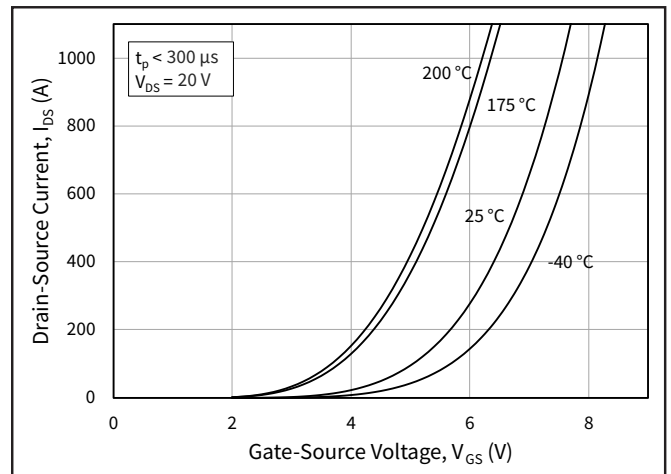


Figure 4. Transfer Characteristic for Various Junction Temperatures

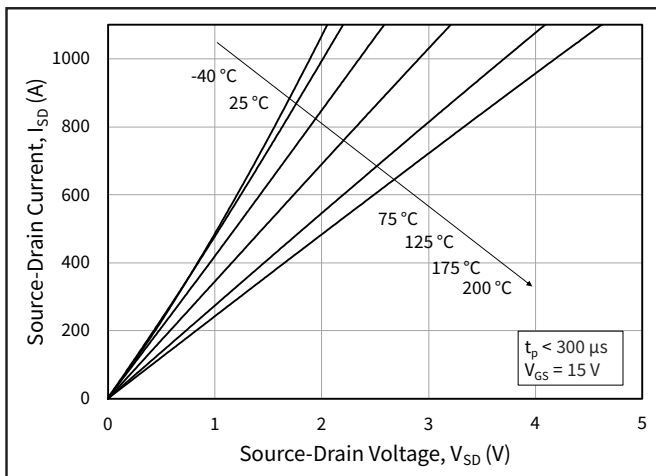


Figure 5. 3<sup>rd</sup> Quadrant Characteristic vs. Junction Temperatures at  $V_{GS} = 15\text{ V}$

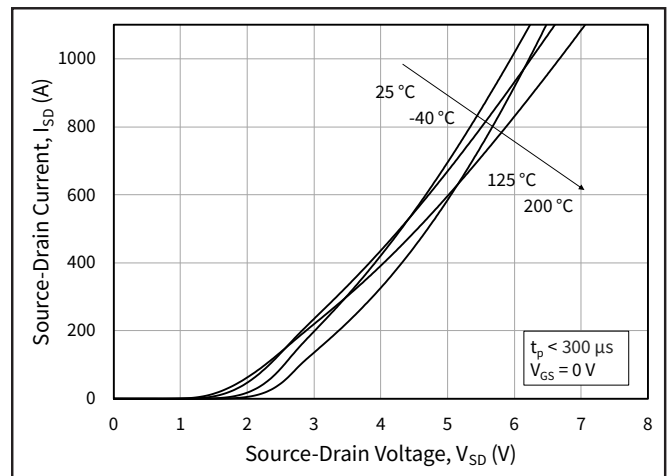


Figure 6. 3<sup>rd</sup> Quadrant Characteristic vs. Junction Temperatures at  $V_{GS} = 0\text{ V}$  (Body Diode)



Typical Performance

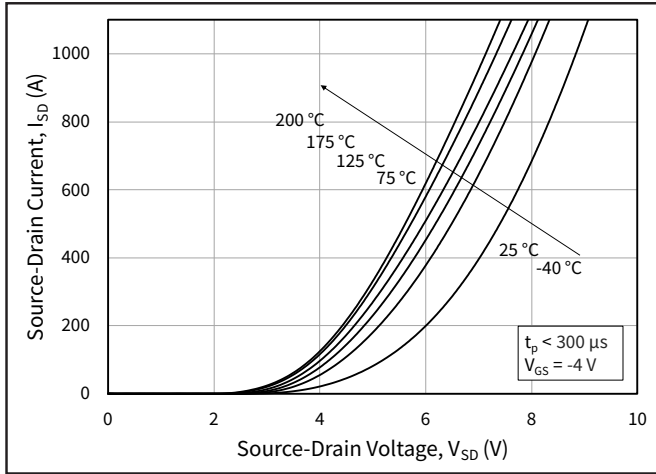


Figure 7. 3<sup>rd</sup> Quadrant Characteristic vs. Junction Temperatures at  $V_{GS} = -4$  V (Body Diode)

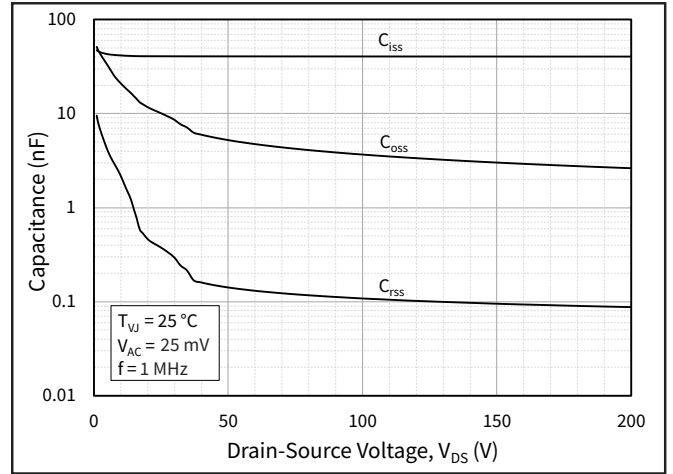


Figure 8. Typical Capacitances vs. Drain to Source Voltage (0 - 200 V)

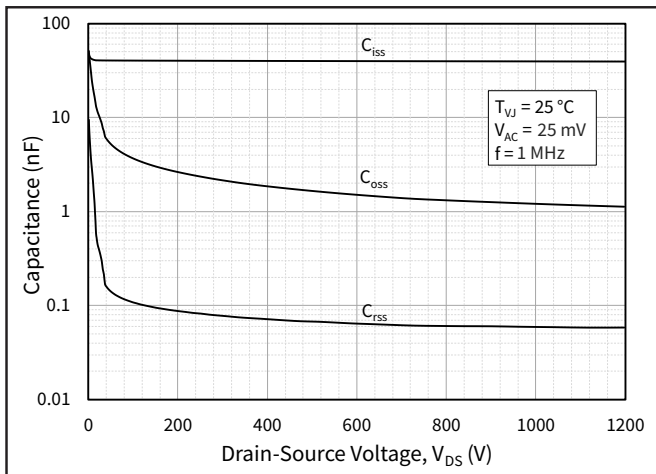


Figure 9. Typical Capacitances vs. Drain to Source Voltage (0 - 1200V)

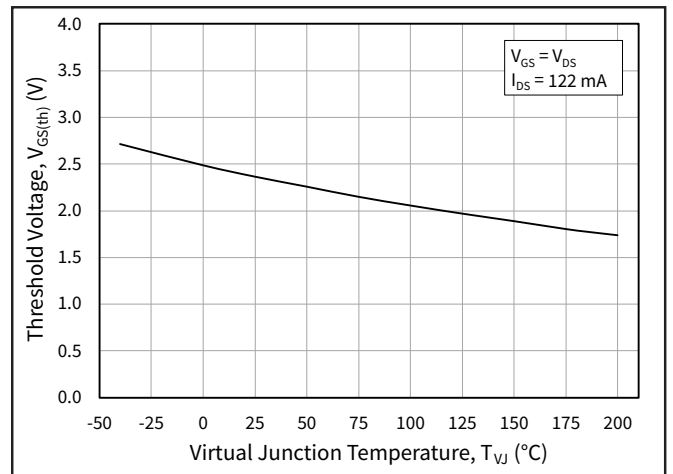


Figure 10. Threshold Voltage vs. Junction Temperature

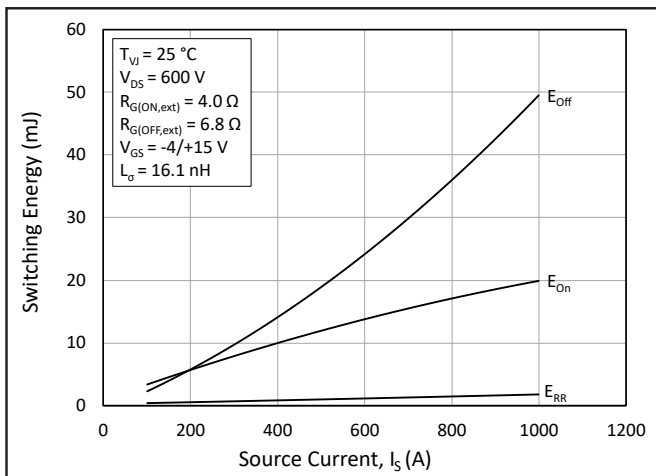


Figure 11. Switching Energy vs. Drain Current ( $V_{DS} = 600$  V)

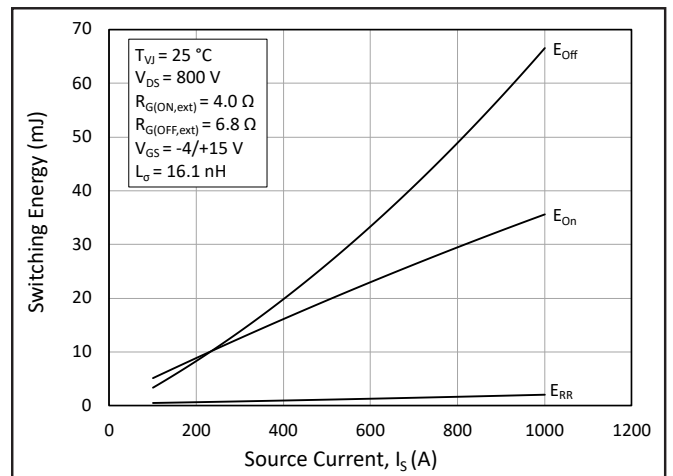
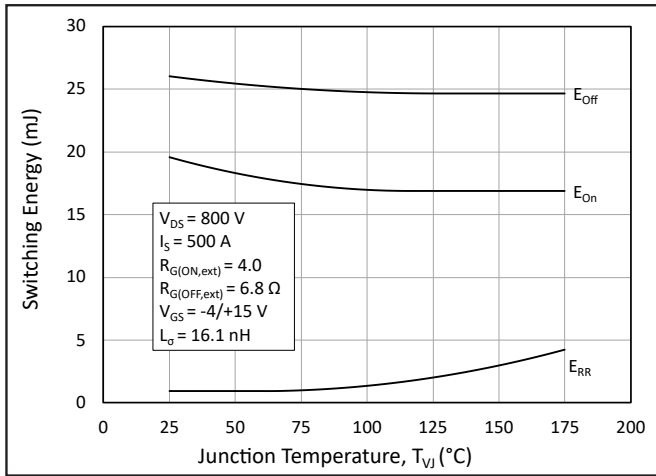


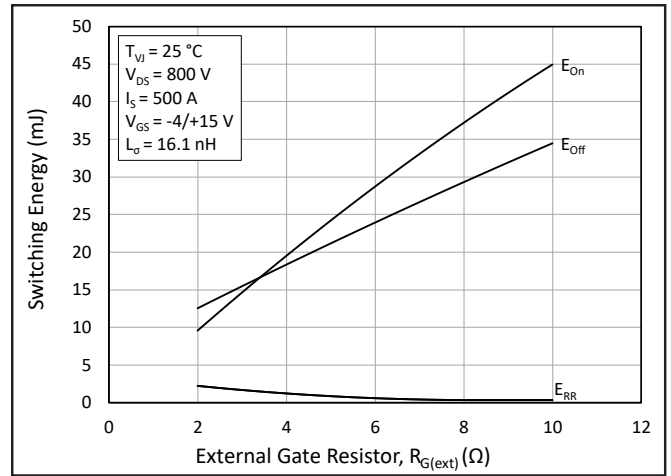
Figure 12. Switching Energy vs. Drain Current ( $V_{DS} = 800$  V)



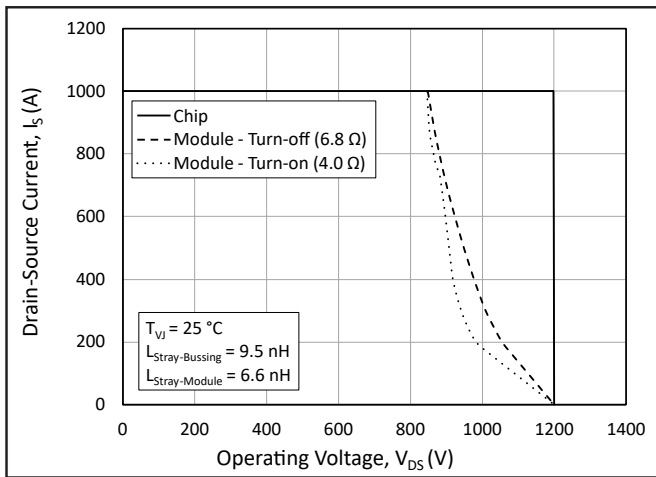
**Typical Performance**



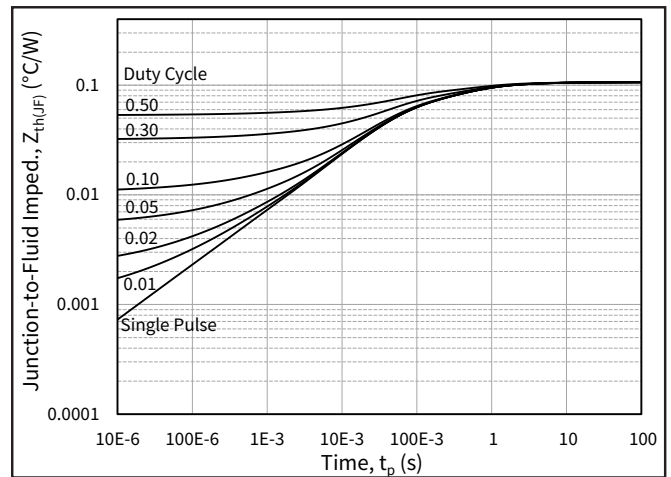
**Figure 13.** Switching Energy vs. Junction Temperature



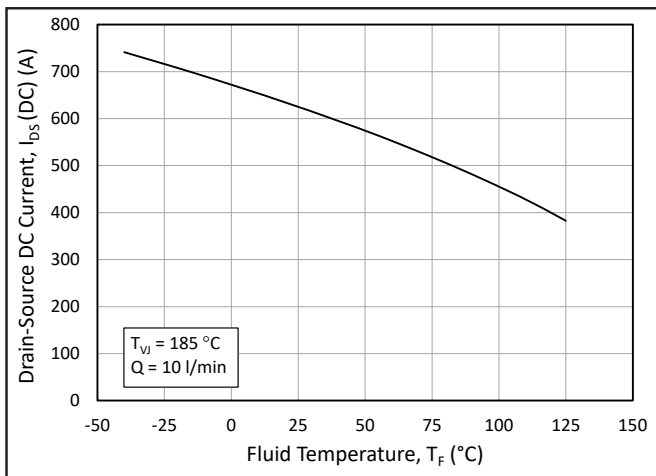
**Figure 14.** Switching Energy vs. External Gate Resistance



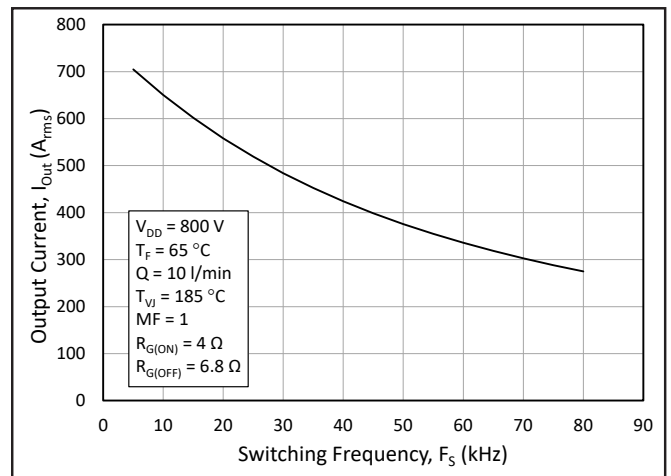
**Figure 15.** Switching Safe Operating Area



**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

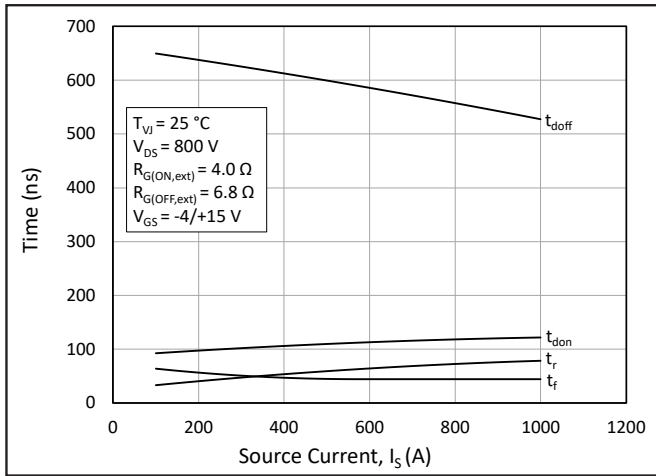


Figure 19. Timing vs. Source Current

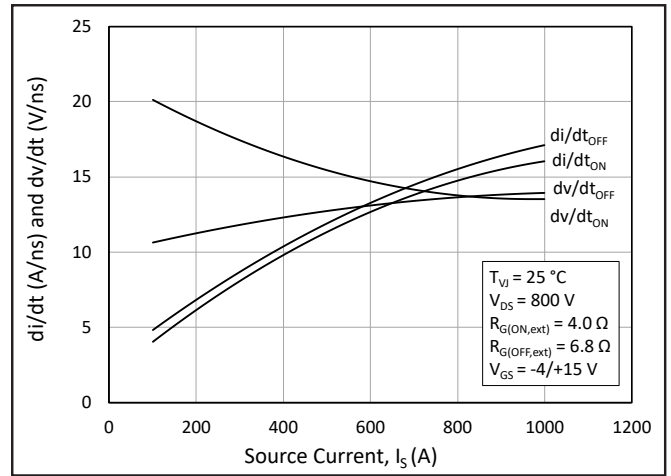


Figure 20.  $dv/dt$  and  $di/dt$  vs. Source Current

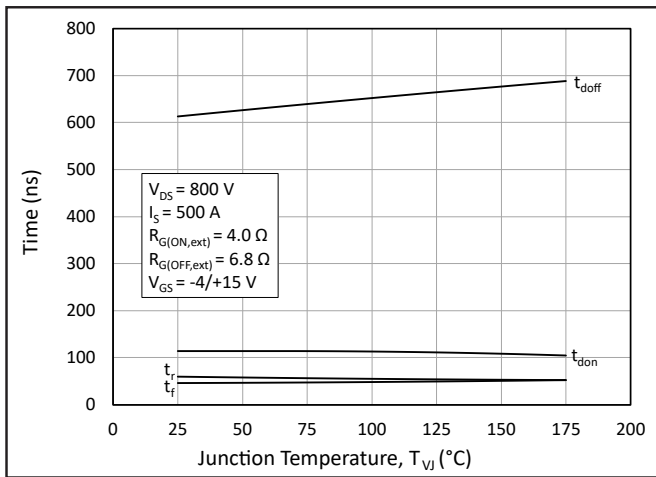


Figure 21. Timing vs. Junction Temperature

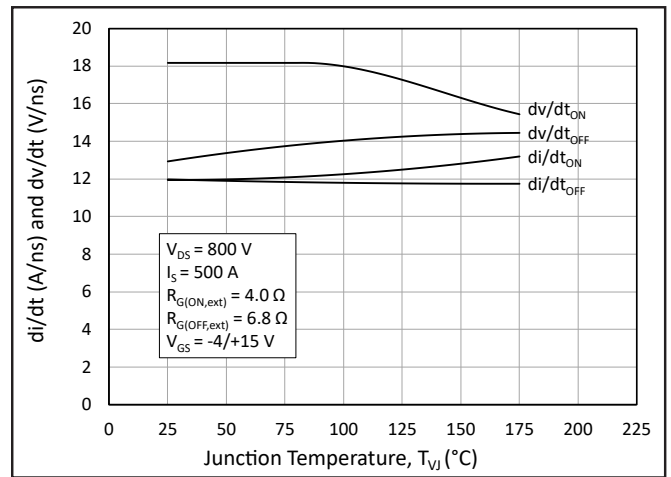


Figure 22.  $dv/dt$  and  $di/dt$  vs. Junction Temperature

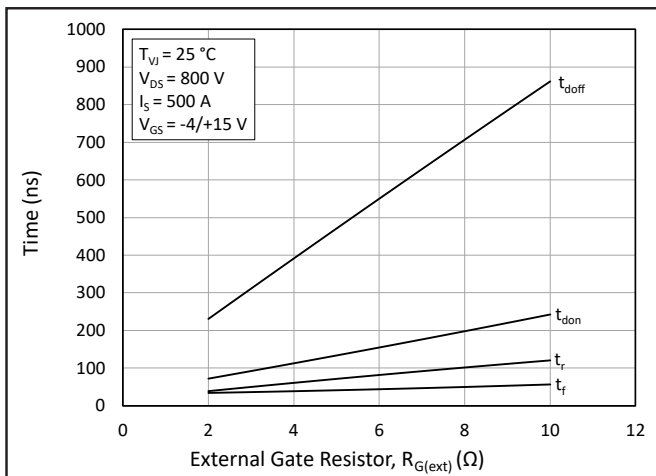


Figure 23. Timing vs. External Gate Resistance

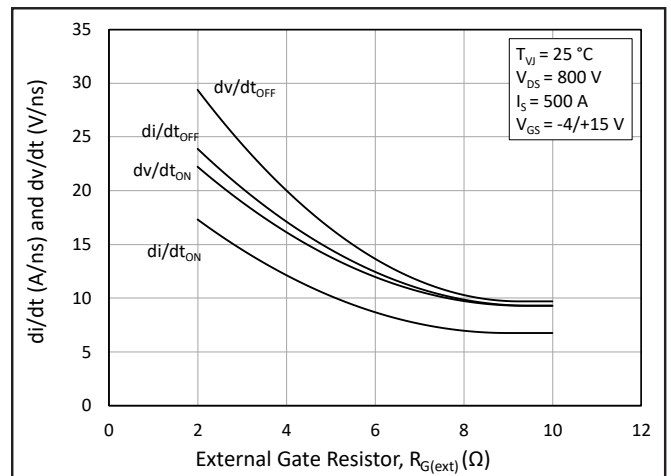
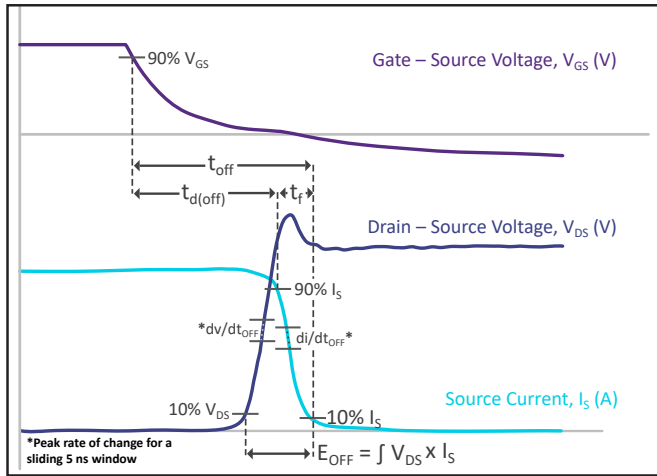
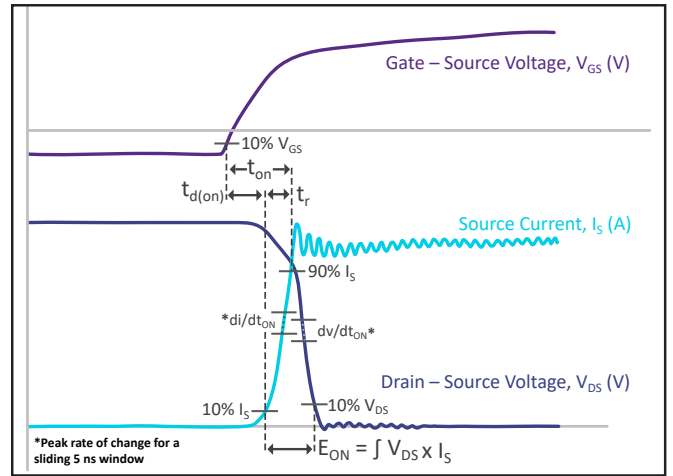


Figure 24.  $dv/dt$  and  $di/dt$  vs. External Gate Resistance

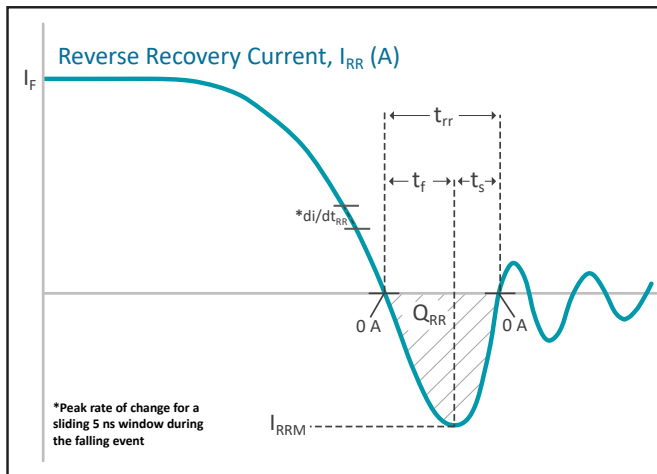
**Definitions**



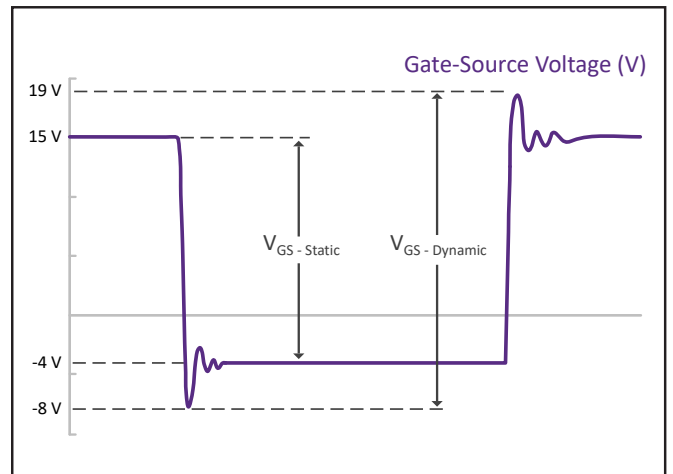
**Figure 25. Turn-Off Transient Definitions**



**Figure 26. Turn-On Transient Definitions**



**Figure 27. Reverse Recovery Definitions**

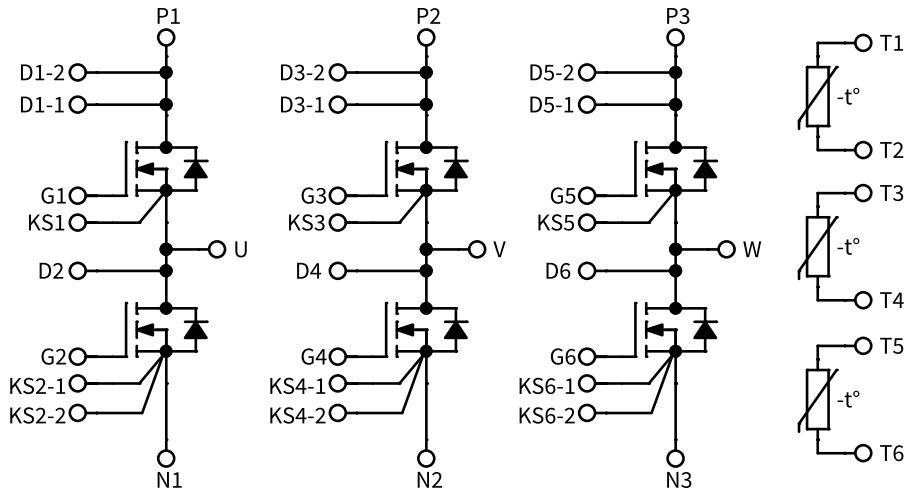


**Figure 28. V<sub>GS</sub> Transient Definitions**

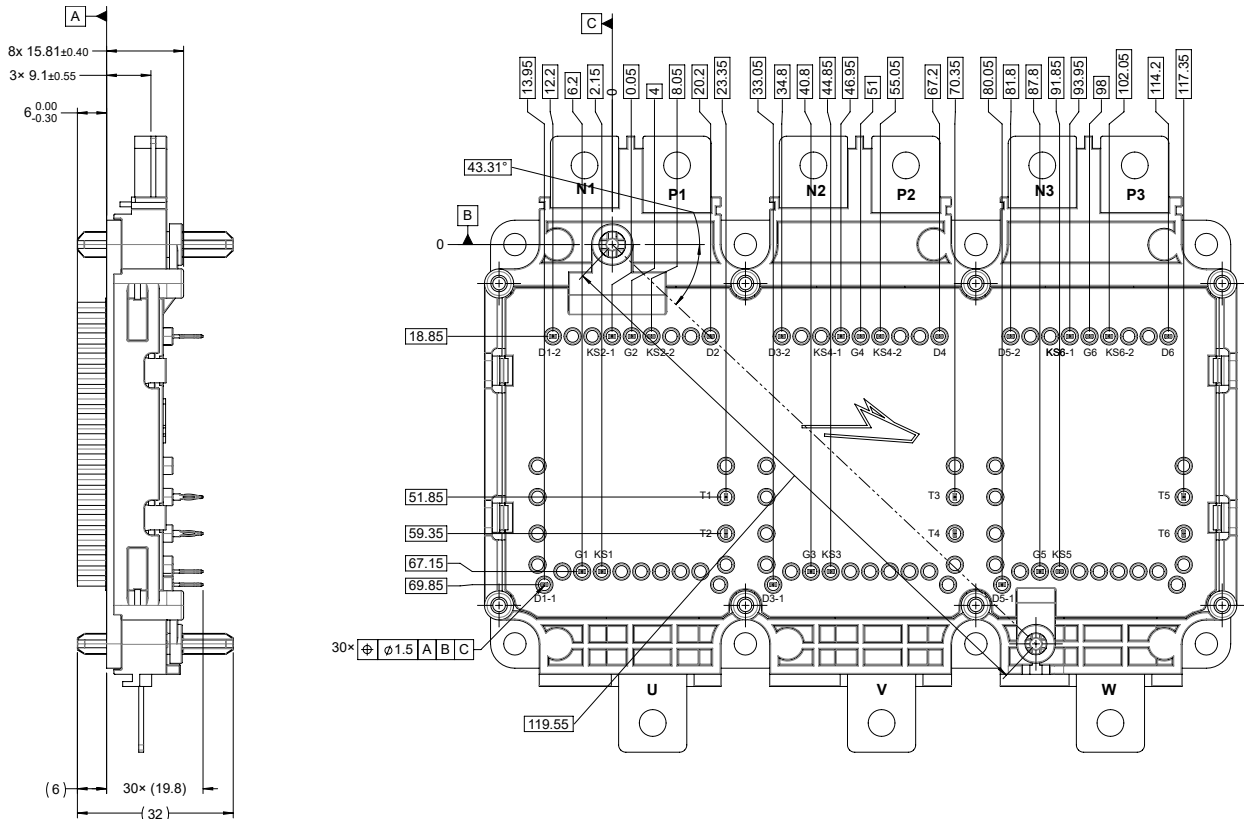
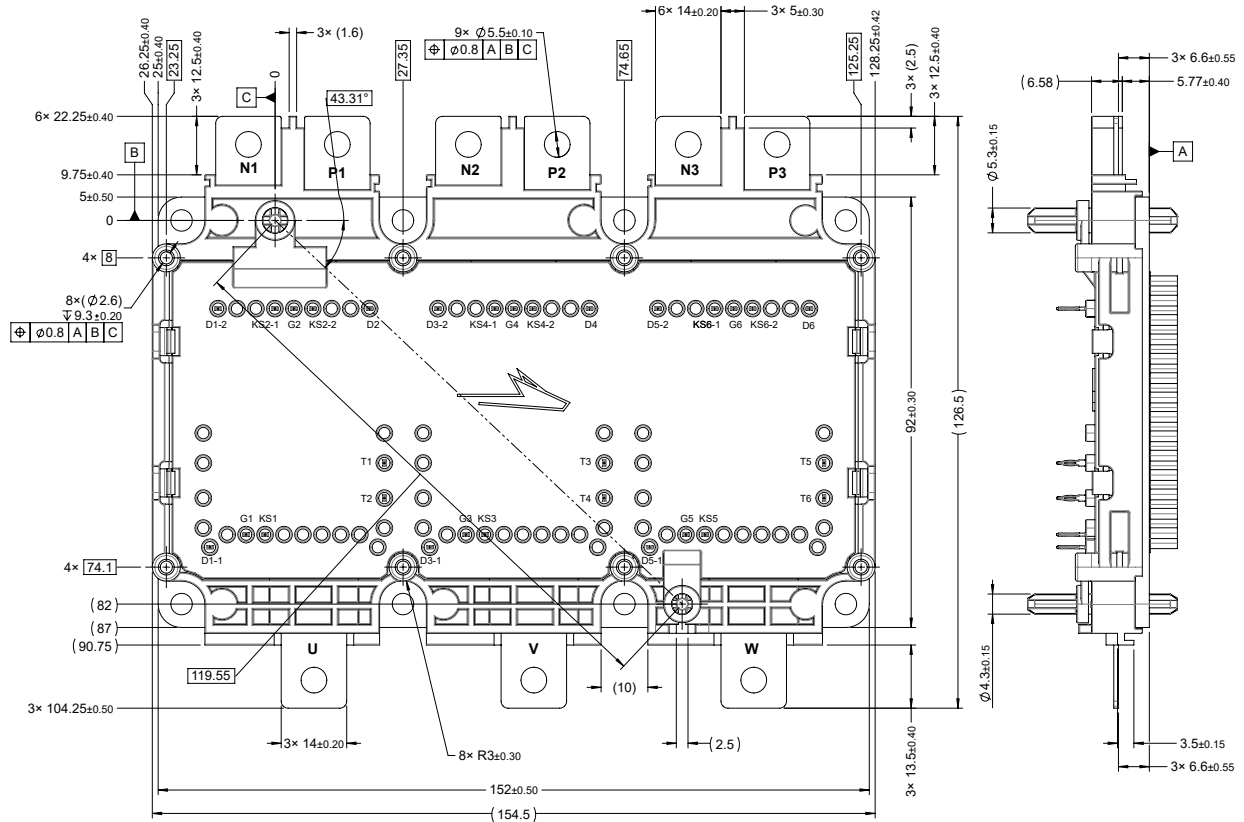
Note: A gate driver featuring the IXDD614SI gate driver IC was used to evaluate dynamic performance. The typical driver high-state output resistance of 0.4 Ω and low-state output resistance of 0.3 Ω are not included in the R<sub>G(ext)</sub> values on this datasheet.



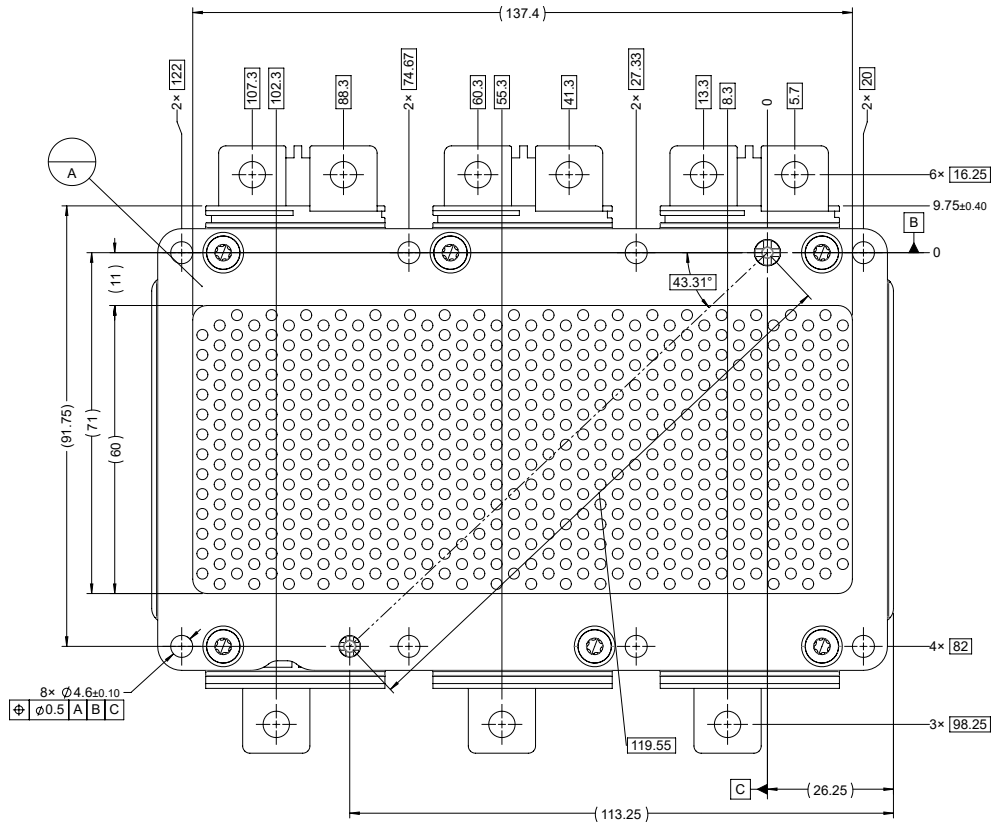
**Schematic and Pin Out**



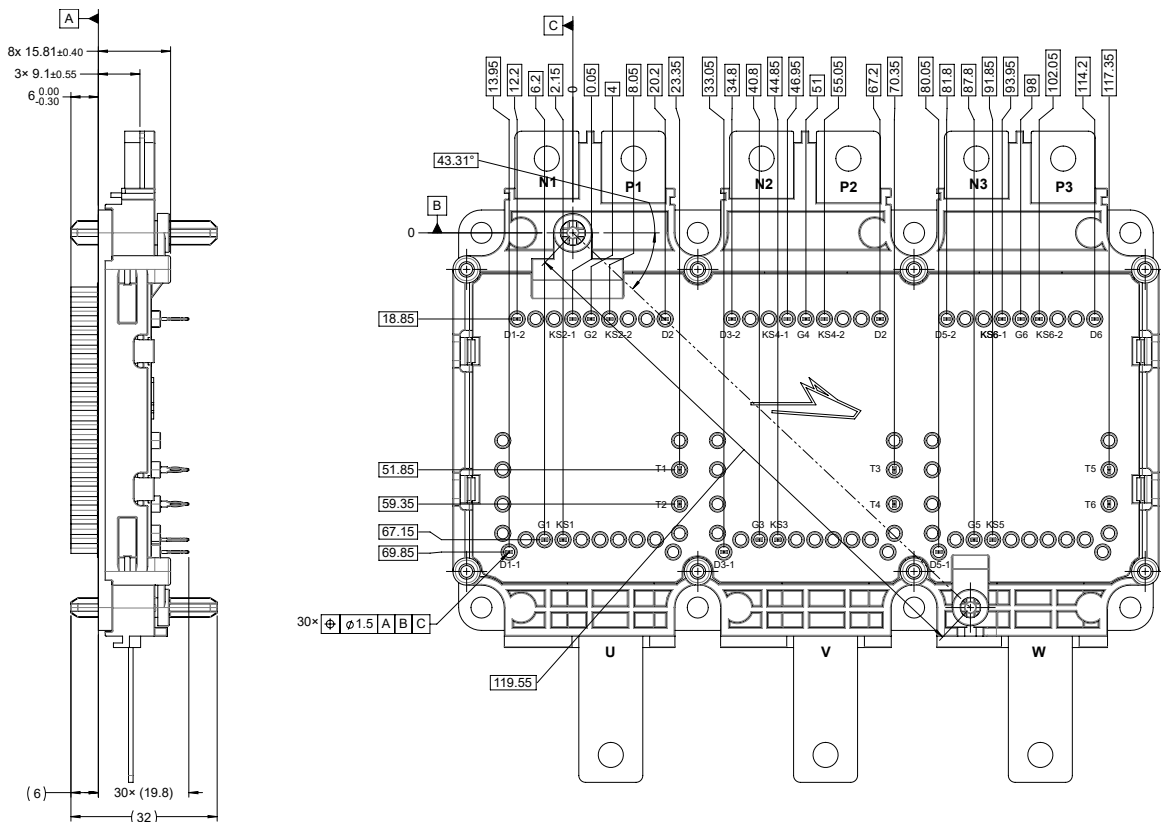
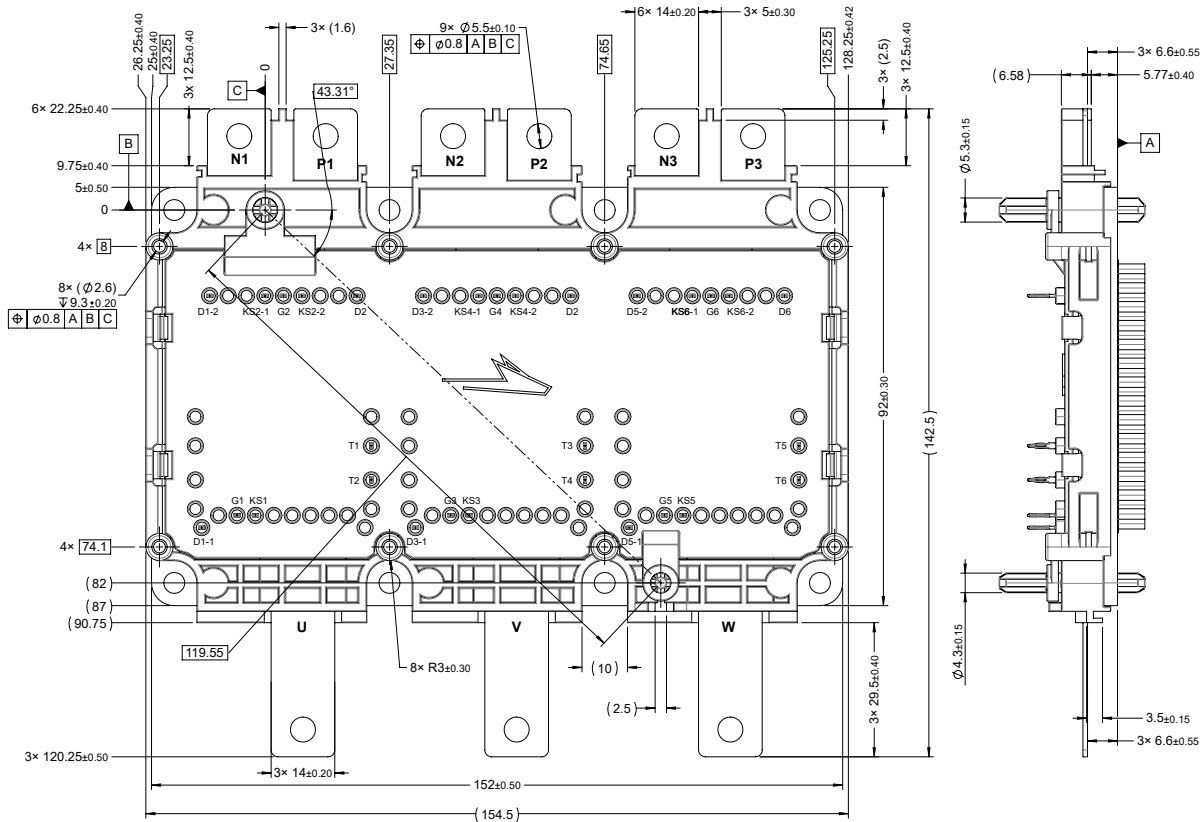
**Package Dimensions (mm), QECCB2R1M12YM4**



**Package Dimensions (mm), QECB2R1M12YM4, Continued**



**Package Dimensions (mm), QECCB2R1M12YM4L**







## Product Ordering Code

Part Number	Description
QECB2R1M12YM4	1200 V, 2.1 mΩ, Silicon Carbide, Six-Pack Module, Short Phase Terminal
QECB2R1M12YM4L	1200 V, 2.1 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

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### **Contact info:**

4600 Silicon Drive  
Durham, NC 27703 USA  
Tel: +1.919.313.5300  
[www.wolfspeed.com/power](http://www.wolfspeed.com/power)