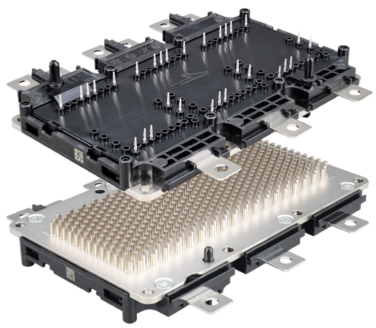
QECB3R1M12YM4, QECB3R1M12YM4L

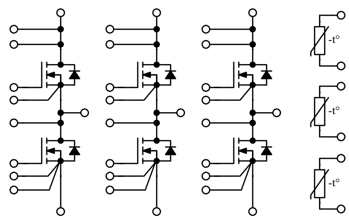
1200 V, 3.1 mΩ, Silicon Carbide, Six-Pack Module

V_{DS}	**1200 V**
$R_{DS(on)}$	**3.1 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. 15
Gate-Source Voltage, Recommended	$V_{GS(op)}$		-4/+15		V	Static	Notes 1, 2 Fig. 15
Implementable Current, Inverter Operation	I_{IMP}		TBD		A_{RMS}	T_F = 65 °C, F_S = 10 kHz	
DC Continuous Drain Current	I_D		450		A	T_F = 25 °C; V_{GS} = 15 V, Q = 10 l/min, T_{VJ} ≤ 185 °C	Notes 3, 4 Fig. 11
DC Continuous Drain Current	I_D		390		A	T_F = 65 °C; V_{GS} = 15 V, Q = 10 l/min, T_{VJ} ≤ 185 °C	Notes 3, 4 Fig. 11
Power Dissipation	P_D		1190		W	T_F = 25 °C, Q = 10 l/min, T_{VJ} ≤ 185 °C	Note 4
Virtual Junction Temperature	$T_{VJ(op)}$	-40		185	°C	Continuous operation	
Virtual Junction Temperature	$T_{VJ(op)}$			200	°C	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): $P_D = (T_{VJ} - T_F)/R_{th(JF,typ)}$

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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 = 82 mA	Fig. 10
			1.8			T_{VJ} = 185 °C		
Zero Gate Voltage Drain Current	I_{DSS}		4	40	µA	V_{GS} = 0 V, V_{DS} = 1200 V		
Gate-Source Leakage Current	I_{GSS}		40	400	nA	V_{GS} = 15 V, V_{DS} = 0 V		
Drain-Source On-State Resistance (Devices Only)	$R_{DS(on)}$		3.1	3.9	mΩ	T_{VJ} = 25 °C	V_{GS} = 15 V, I_D = 300 A	Figs. 2, 3
			5.6			T_{VJ} = 175 °C		
			5.9			T_{VJ} = 185 °C		
			6.3			T_{VJ} = 200 °C		
Transconductance	g_{fs}		240		S	T_{VJ} = 25 °C	V_{DS} = 20 V, I_D = 300 A	Fig. 4
			236			T_{VJ} = 185 °C		
Internal Gate Resistance	$R_{G(int)}$		1.1		Ω	V_{AC} = 250 mV, f = 100 kHz		
Input Capacitance	C_{iss}		26.6		nF	V_{GS} = 0 V, V_{DS} = 800 V, V_{AC} = 250 mV, f = 100 kHz		Fig. 9
Output Capacitance	C_{oss}		0.9		nF			
Reverse Transfer Capacitance	C_{rss}		41		pF			
Thermal Resistance, Junction to Fluid	$R_{th(JF)}$		0.135		°C/W	Single switch, Q = 10 l/min, T_F = 65 °C		

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} = 300 A	Fig. 7
			5.5			T_{VJ} = 185 °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 5
Package Resistance, Low-Side	$R_{pkg(LS)}$		0.22		mΩ	T_F = 25 °C	Note 5
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 (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 °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

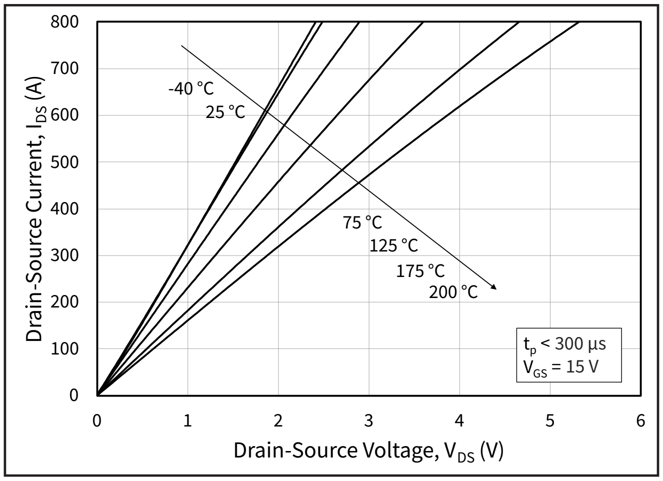


Figure 1. Output Characteristics for Various Junction Temperatures

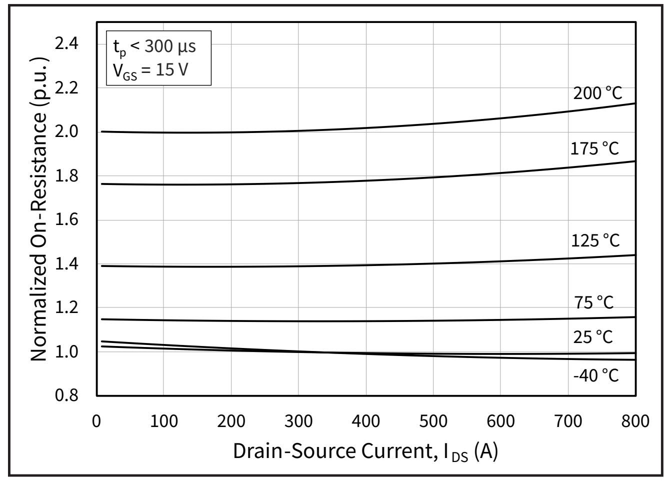


Figure 2. Normalized On-State Resistance vs. Drain Current for Various Junction Temperatures

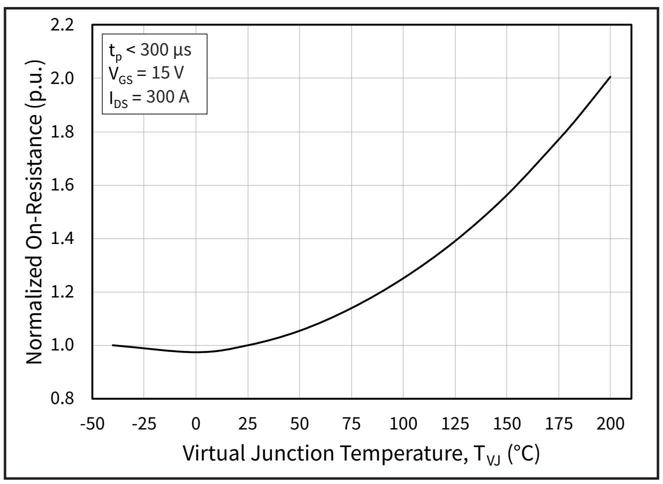


Figure 3. Normalized On-State Resistance vs. Junction Temperature

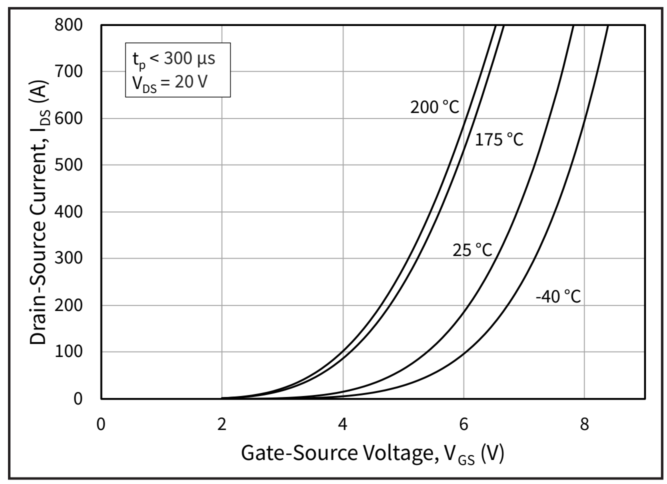


Figure 4. Transfer Characteristic for Various Junction Temperatures

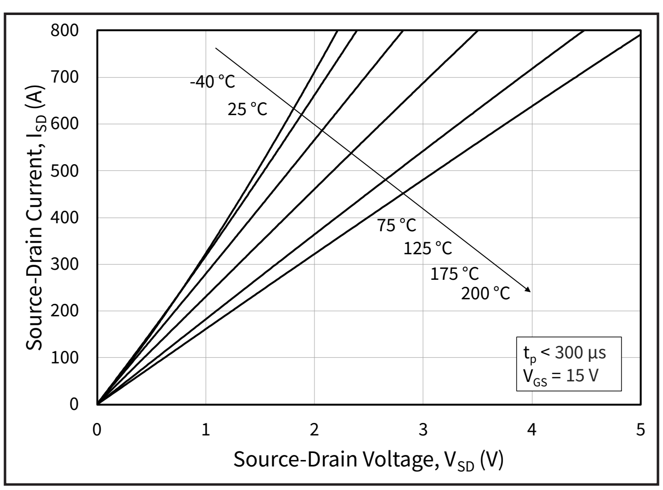


Figure 5. 3rd Quadrant Characteristic vs. Junction Temperatures at V_{GS} = 15 V

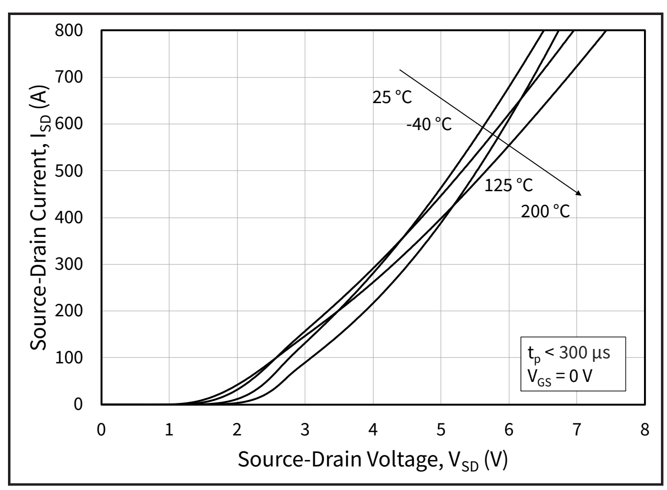


Figure 6. 3rd Quadrant Characteristic vs. Junction Temperatures at V_{GS} = 0 V (Body Diode)

Typical Performance

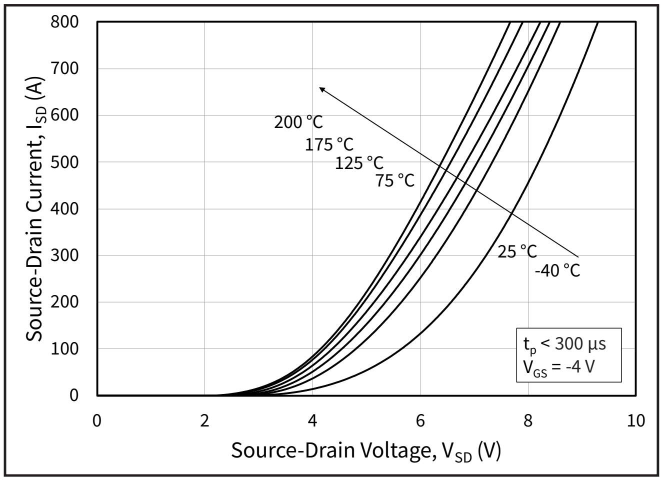


Figure 7. 3^{rd} Quadrant Characteristic vs. Junction Temperatures at V_{GS} = -4 V (Body Diode)

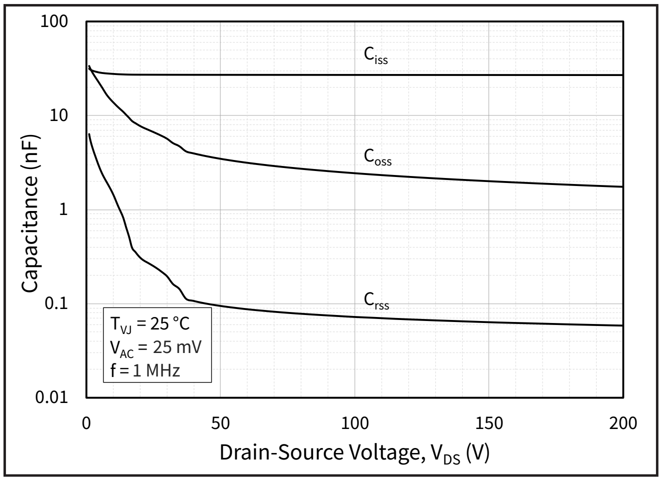


Figure 8. Typical Capacitances vs. Drain to Source Voltage (0 - 200 V)

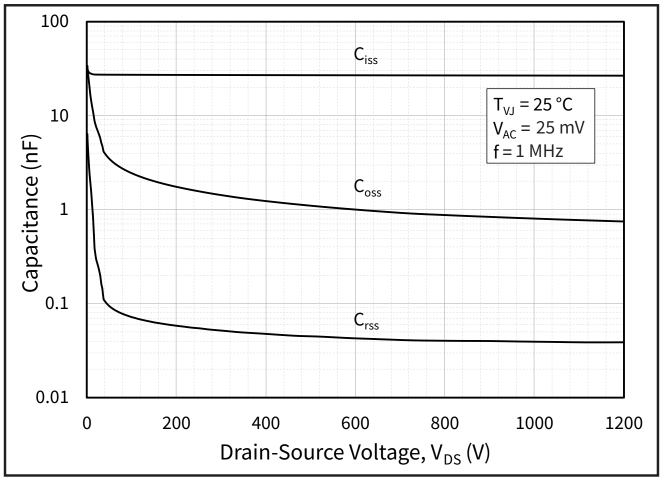


Figure 9. Typical Capacitances vs. Drain to Source Voltage (0 - 1200V)

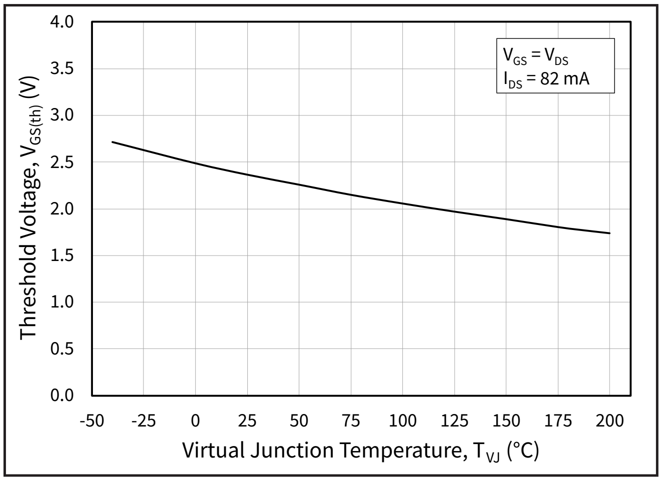


Figure 10. Threshold Voltage vs. Junction Temperature

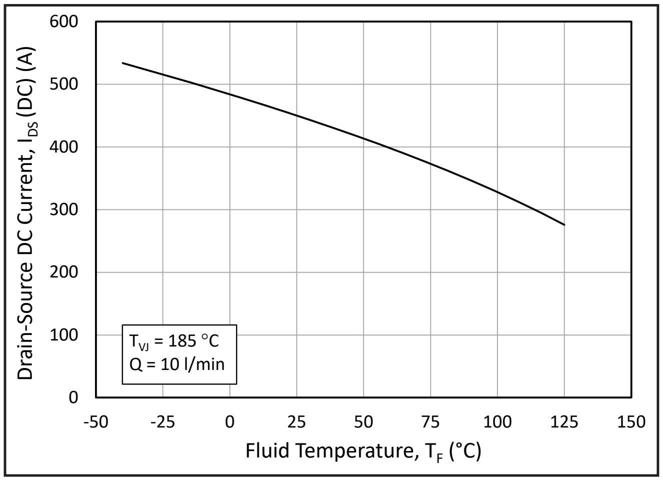


Figure 11. Continuous Drain Current Derating vs. Fluid Temperature

Definitions

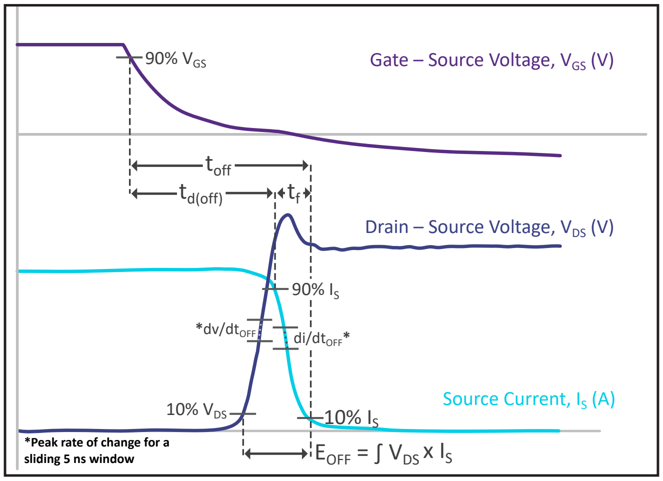


Figure 12. Turn-Off Transient Definitions

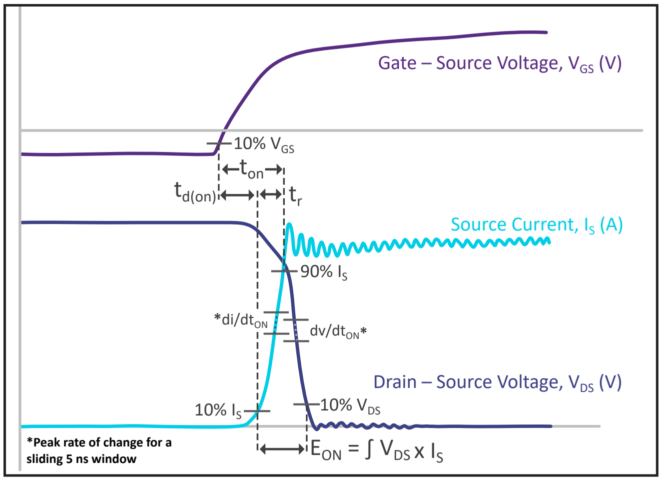


Figure 13. Turn-On Transient Definitions

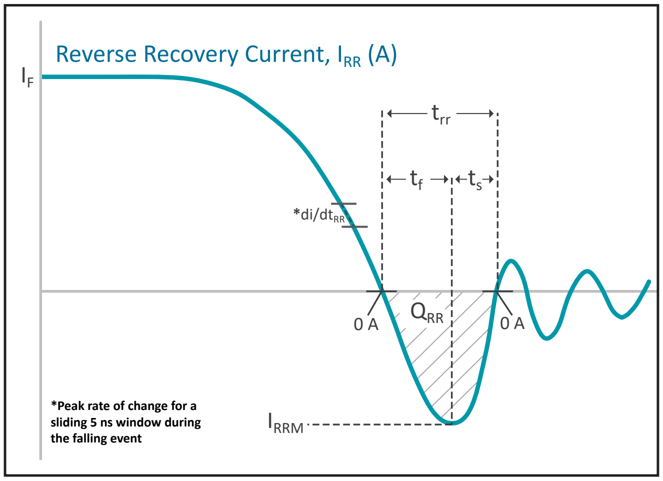


Figure 14. Reverse Recovery Definitions

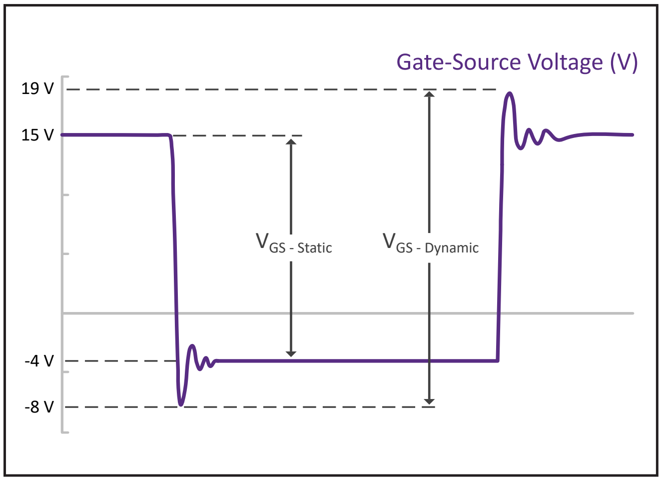
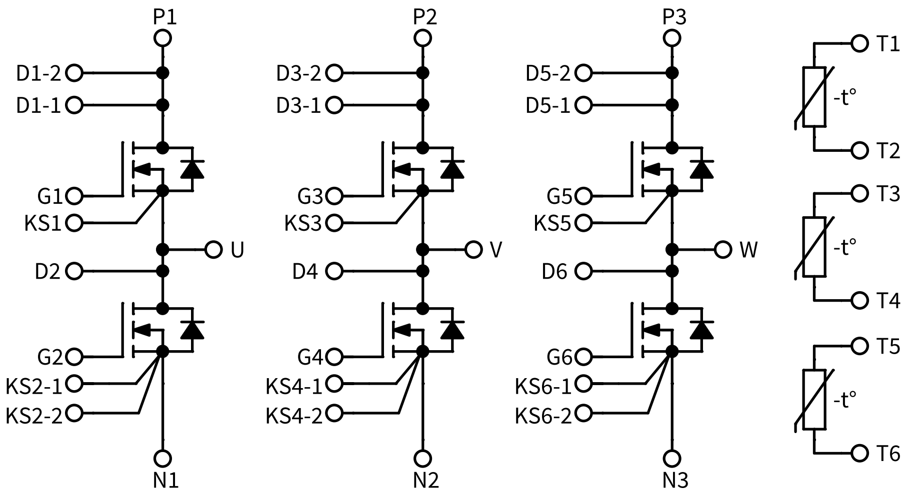


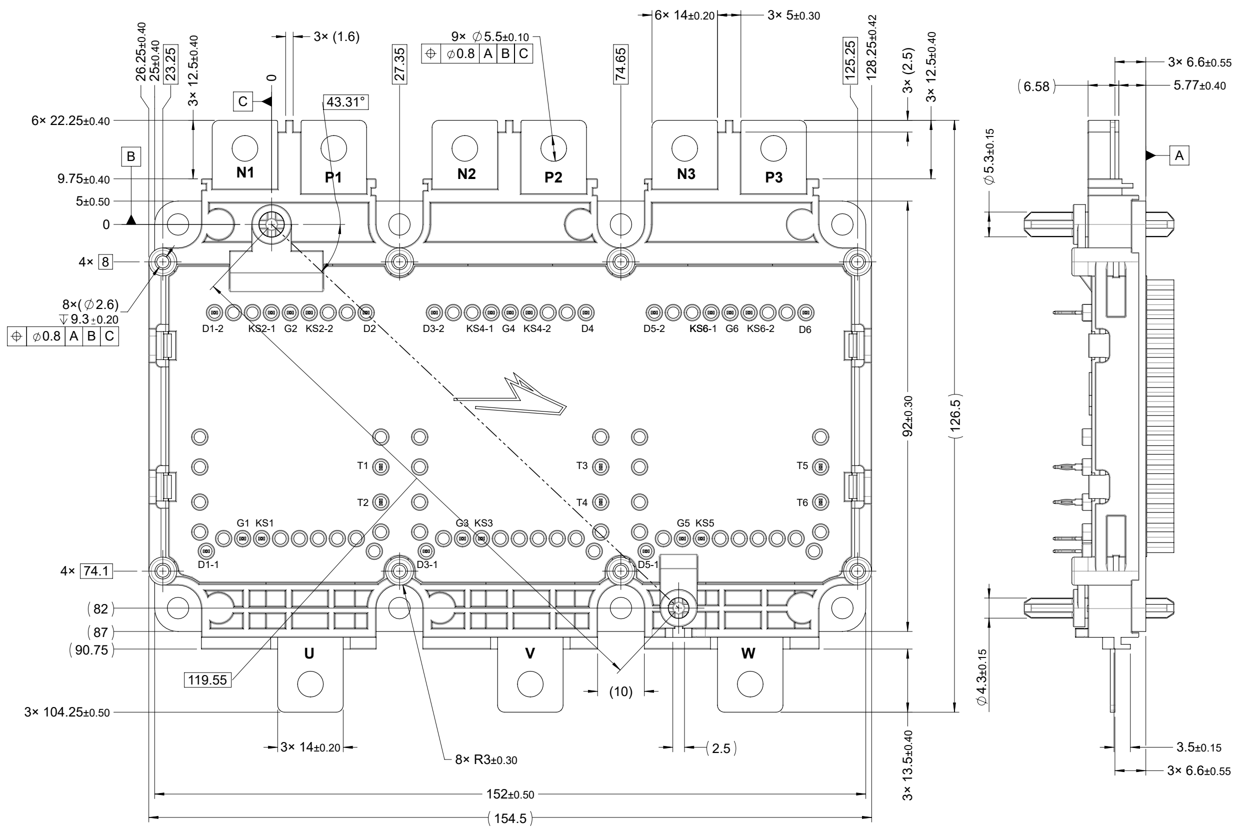
Figure 15. V_{GS} Transient Definitions

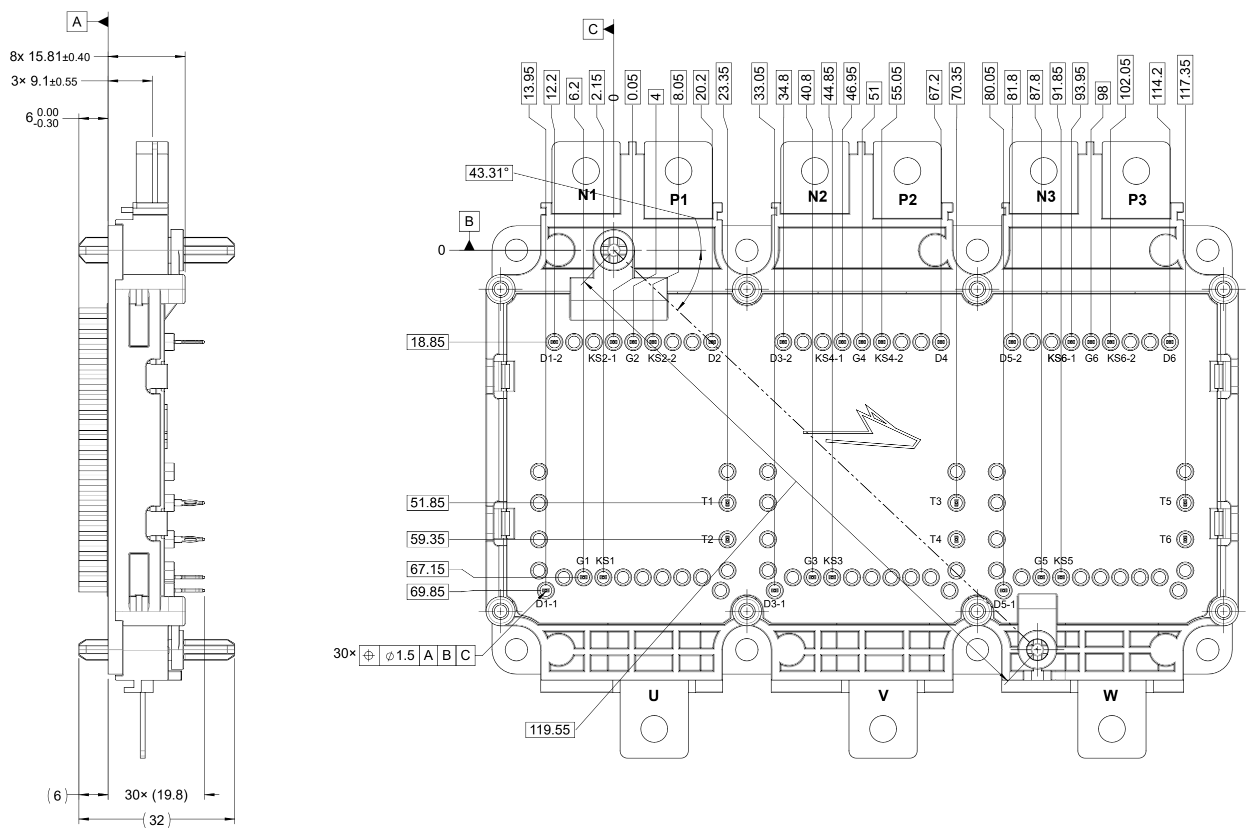
Note: A gate driver featuring the IXDD614SI gate driver IC was used to evaluate dynamic performance. The typical driver high-state output resistance of 0.4 Ω and low-state output resistance of 0.3 Ω are not included in the $R_{G(ext)}$ values on this datasheet.

Schematic and Pin Out

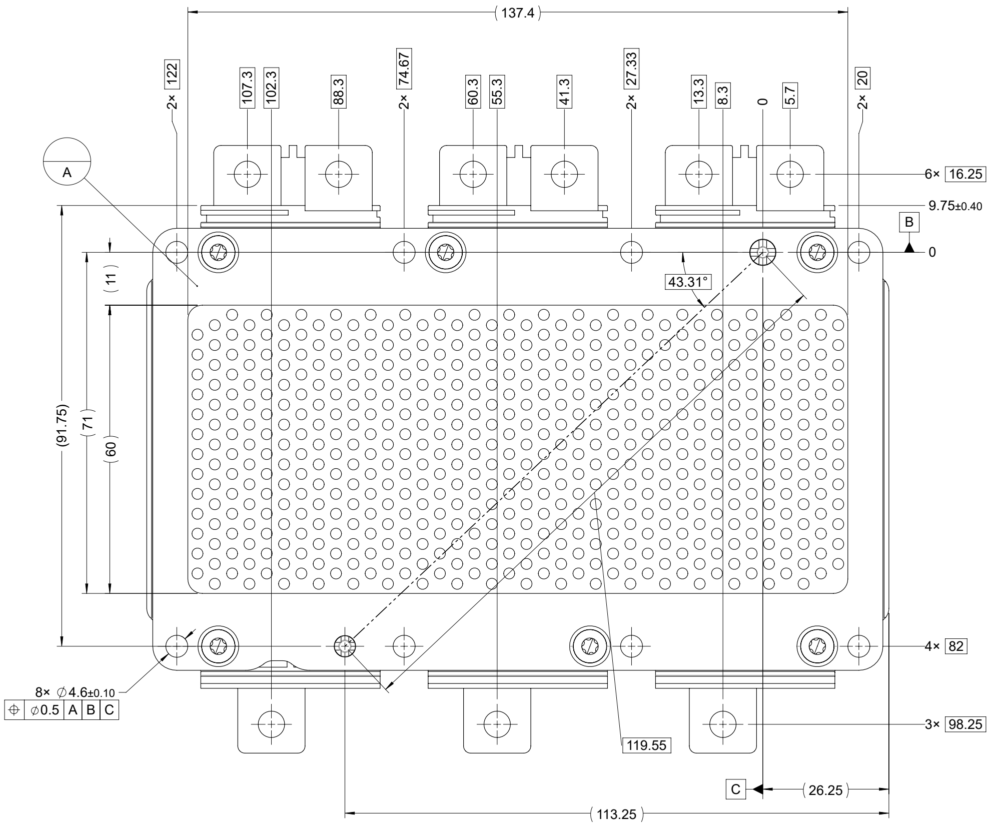


Package Dimensions (mm), QECB3R1M12YM4

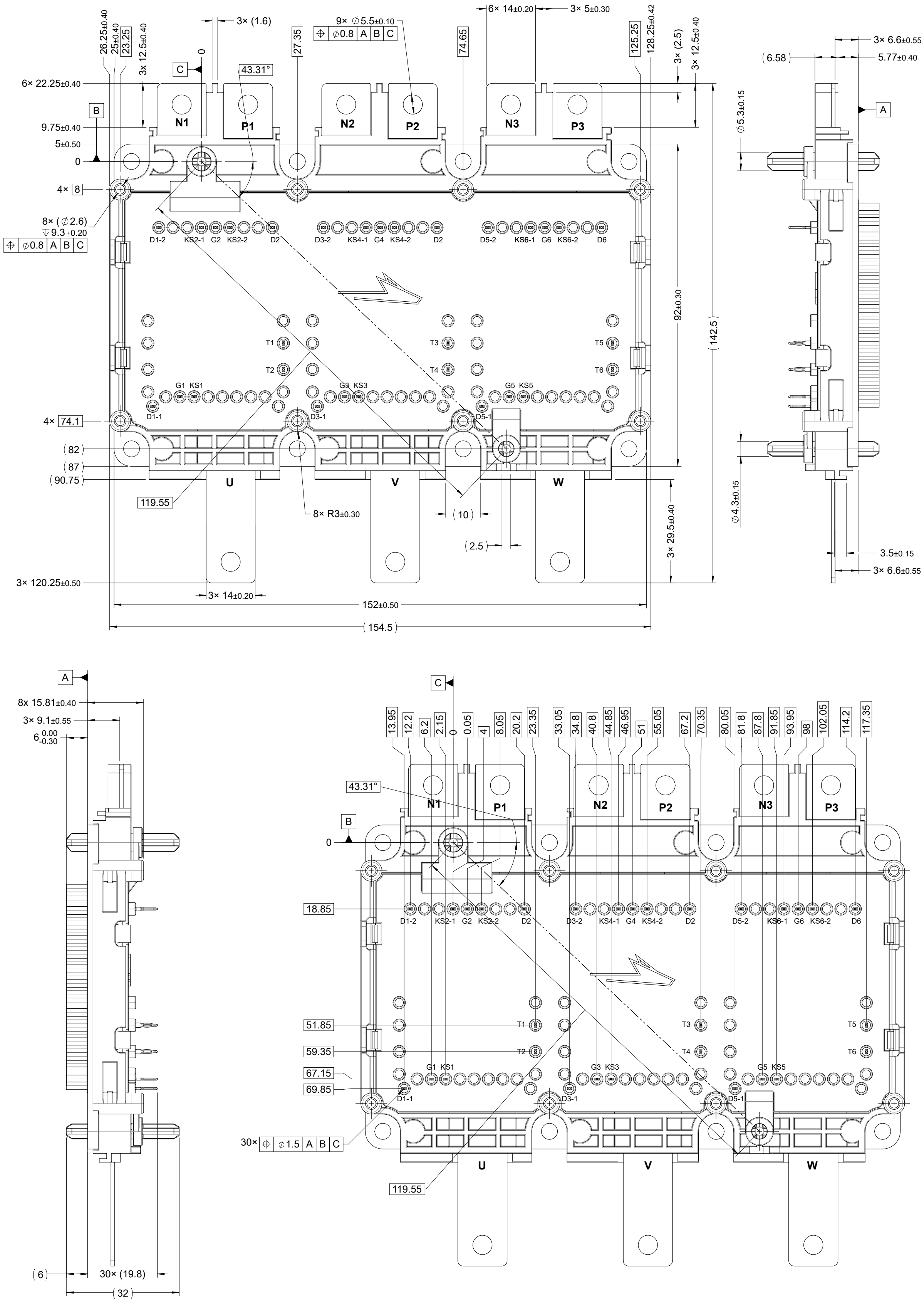




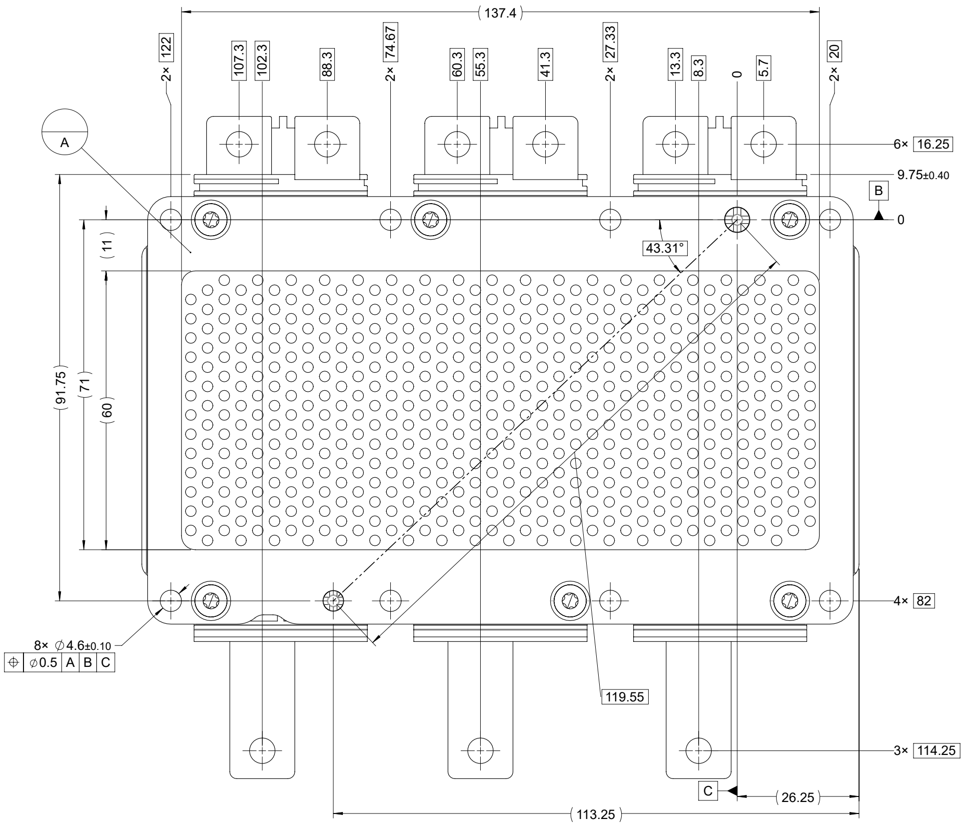
Package Dimensions (mm), QECB3R1M12YM4, Continued



Package Dimensions (mm), QECB3R1M12YM4L



Package Dimensions (mm), QECB3R1M12YM4L, Continued



Product Ordering Code

Part Number	Description
QECB3R1M12YM4	1200 V, 3.1 mΩ, Silicon Carbide, Six-Pack Module Short Phase Terminal
QECB3R1M12YM4L	1200 V, 3.1 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

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